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The Forty-Ninth Meeting of the American Astronomical Society

By DEAN B. McLAUGHLIN

The American Astronomical Society held its forty-ninth meeting at Atlantic City, in affiliation with the American Association for the Advancement of Science, from Tuesday to Thursday, December 27 to 29, 1932. Seventy-six members signed the register. Some, to make sure they were noticed, entered their names twice. The Pacific coast was well represented for an eastern meeting; President Adams, Ex-President Campbell, and Dr. J. H. Moore, retiring chairman of Section D, were present.

Headquarters of the Society were at the Hotel Madison, and practically all members were lodged there. Simultaneously with the astronomical meetings, the phytopathologists were holding their sessions in the hotel. It is probable that the most discussed question among astronomers on the first day was not the size of the universe or the constitution of stars, but "What is a phytopathologist?" Some, doubtless believing in the omniscience of secretaries as a class, put the question to the secretary and assistant secretary with obviously sincere expectation of receiving an answer. Others, less willing to admit their ignorance, proceeded by the more scientific method of observation and inference.

The Hotel Madison is located "just off the boardwalk," meaning a rather long block from it. Without doubt the darkest place on earth is midway between the Madison and the boardwalk on a rainy night. The writer, returning from Convention Hall on Tuesday evening, was so thoroughly convinced that no good could come of venturing into such a dark street that he walked about a quarter mile past, and was quite unable to identify the field. In better weather he would have "swept" for it; as it was, he found the hotel with the aid of a policeman (in an advisory capacity only).

Rain has been briefly referred to. It began Tuesday evening and served to dampen the spirits of some who otherwise would have attended the general session of the Association and the reception which followed. The rain continued faithfully throughout Wednesday. Undoubtedly it interfered with constitutionals on the boardwalk, and related extra-curricular activities, including the purchase of salt-water taffy. The ocean was on its good behavior at all times during the meetings, and the temperature of the air was not uncomfortably low.

There was no dinner for the Society as a whole. Most members

took their meals in the hotel dining room in groups up to six in number. Such discussion groups were quite enjoyable and made up for the loss of the usual speeches. Entertainment was not wholly left out, as Dr. Abbot was heard to sing at least one nautical ditty to a small but appreciative audience. It is inferred that astronomers as a class are too poor to summer at resort hotels. This conclusion is based on the observation that few seemed to know whether they were on "European" or "American" plan.

In the evenings after the general sessions of the Association, astronomers gathered in small groups in the lobby and lounge to discuss at length various matters of astronomy and education, or to hear tales of the "old days" in the Society. These discussions continued until it became evident that the elevator boy was anxious to get some sleep.

The council held two meetings for the transaction of routine business, and six new members were elected to the Society. Four sessions for papers were held in the Dutch Room of the hotel. Ex-President Campbell presided at one of these, and President Adams at the others. On Wednesday afternoon J. H. Moore, former chairman of Section D, delivered his retiring address on "Solar Eclipse Problems."

The program of papers included thirty-seven titles on a variety of subjects. Solar eclipses received somewhat more than average attention. Dr. Moore, in his address already referred to, summarized eclipse problems in general. Motion pictures showing the changing illumination of the landscape during the eclipse, as seen from an airplane, were exhibited by W. M. Browne. In a paper by Lee, with C. F. Marvin and E. C. Bryant, it was concluded that the Einstein deflection of light cannot be due to refraction caused by chilling of the atmosphere in the shadow cone. Stearns presented a general account of the Van Vleck Observatory expedition. Morehouse and Fox gave a measurement of the depth of the chromosphere on eclipse plates. Menzel suggested that prominences may be supported by radiation pressure from a very hot spot at the root of the prominence. A demonstration of the Franklin Institute eclipse projector was given by Stokley.

Meteors also received more than usual attention. Two papers, by Olivier and Millman respectively, dealt with the Leonids of 1932. The latter reported obtaining several new meteor spectra. Mrs. Wills presented a discussion of some thousands of observations by the American Meteor Society. F. A. Melton and William Schriever described and showed photographs of numerous large elliptical depressions which have been found in the Atlantic coastal plain region in the Carolinas. These are attributed to the impact of a swarm of meteors.

Three papers were concerned with fundamental astronomy. Littell showed that the photographic zenith tube can be used to determine time more accurately than the meridian circle. H. R. Morgan confirmed the accuracy of the system of declinations of Newcomb's Fundamental Catalog. In a paper by Loomis and Stetson, small changes of longitude

were correlated with the hour angle of the moon. Another effect attributed to the moon was discussed by Johnson in a paper on radio reception correlated with lunar tidal force.

Probably the most extensively discussed of the papers was by Adams and Dunham, showing that the oxygen in the atmosphere of Mars is much smaller in amount than previously supposed. The formation of rays about lunar craters was treated by Hacker and Stewart, who calculated the energy required to eject ray-forming material from the craters.

Measurement of the feeble light of the Gegenschein by means of a photo-electric cell was reported in a paper by Elvey. Other feeble radiations in the sky were the subject of a paper by V. M. Slipher, who found numerous wave-lengths besides the previously known auroral lines and bands. It was further shown that the green auroral line is not always especially characteristic of auroral displays.

Papers dealing with objects outside the solar system constituted slightly more than half of the program. Russell and Miss Moore gave new determinations of average masses of giant stars, and Barton reported on discovery of doubles in the published Astrographic Catalogs. Vyssotsky's observations of the companion of Sirius show it to be rather brighter than the magnitude usually quoted. Space motions of stars in the Orion and Scorpius-Centaurus clusters formed the subject of a paper by F. D. Miller.

Studies of stellar spectra were not very numerous. Adams showed that blending of interstellar and stellar lines of sodium probably occurs in the spectra of some giant stars. Peculiar differences of intensity of lines in the two peculiar spectra of 17 Leporis and ϵ Aurigae were pointed out in a paper by J. A. Hynek. The Be stars were discussed in two papers,—on the discovery of these objects, by Merrill and Miss Burwell, and on structure in the helium lines in some of these spectra, by Mohler and Miss Dodson.

Methods of photometry and studies of variable stars received their share of attention. J. S. Hall showed how the Loomis telescope is being used with a caesium oxide photo-electric cell for photometry in the infra-red. Miss Payne discussed heterochromatic photometry by the use of various combinations of plates and filters. Dugan presented a contrast in eclipsing binaries: SX Cassiopeiae, large and of low density, and VW Cephei, a small dense pair. The light curve of the notorious R Scuti was analysed by Alter, who found hidden periodicities and considers the star more regular than previously supposed. McLaughlin showed correlations of light and velocity curves of two red variable stars.

The discovery of new variables in globular clusters was reported in a paper by Miss Sawyer, bringing us to the last sub-division of the program. Van de Kamp, by taking account of absorption of light in space, concluded that the globular clusters form a nearly spherical

system, densest at the center. Vyssotsky and "Miss Williams" (*nom de plume*) showed that the globular clusters nearest the Milky Way are reddest, probably due to selective absorption of light. A paper by Keenan dealt with surface brightness of elliptical nebulae, and one by van Maanen gave results of proper motion measures of planetary nebulae, and probable masses and luminosities of the central stars which may be "very luminous white dwarfs."

One thing that contrasted with some other meetings was the apparent lack of necessity for cutting short either the presentation of papers or the discussion. Most authors kept within the scheduled time, and the program of papers was completed on Thursday morning without apparent hurry, in spite of some rather extensive discussion. One wonders if astronomers become economical of words during a depression,—in direct opposition to the effect observed in the case of United States Congressmen.

Astronomy was well represented on the general program of the Association. The annual Sigma Xi Lecture was delivered by Harlow Shapley who spoke on "Fact and Fancy in Cosmogony." The first Hector Maiben Lecture was given by Henry Norris Russell, the subject being "The Constitution of the Stars." These lectures and others were held in the Convention Hall, a mammoth structure in the depths of which (so it seemed to the writer) a good-sized hotel, an Egyptian pyramid, and a state capitol might be easily mislaid.

For the first time in a number of years, the President of the Association is an astronomer, Dr. Henry Norris Russell having been elected to that office at the Atlantic City meeting.

There was, of course, no observatory to visit, nor any other institution to "pinch hit" for an observatory. This, and the lack of social functions of the Society, made the Atlantic City meeting different in some degree from those of the Society by itself. On the other hand, the Association did not loom so large as at some other meetings, and the conduct of the astronomical program was such that the writer can not agree with either of the extreme views: that the Society should *always*, or that the Society should *never*, meet with the Association. At such joint meetings, something is gained on either side, and their recurrence every couple of years is worth encouraging.

Ann Arbor, Michigan, January 21, 1933.

Meteorites and the Age of the Universe

By E. ÖPIK

A new chapter in meteoric science has been opened within the last few years by Professor Fritz Paneth,[1] of Königsberg, and his collaborators. Applying methods similar to those used in the determination of the age of terrestrial rocks, Paneth derives the age of meteorites from their relative content of helium and radium. Chiefly, iron meteorites were investigated, which are supposed to keep helium firmly at temperatures up to 1000° C and perhaps higher. The age derived in this way is believed to represent an upper limit of the time elapsed since the meteorites possessed a temperature sufficiently high for the escape of helium, the possible overestimate amounting to only ten or twenty per cent; the accidental error of one determination is estimated at about ten per cent. Paneth's data refer to twenty-four individually different meteorites, and may be summarized in the following table:

Limits of age, millions of years,	under 500	500-1000	1000-1500	1500-2000
Number of meteorites	4	4	6	3
	2000-2500	2500-3000	above 3000	
	4	3	0	

It seems highly significant that all these values fall below or close to a limit supposed to be the age of the earth and of the solar system; from this fact Paneth concludes that all these meteorites must be also of solar origin; he questions the reality of hyperbolic velocities found for the majority of fireballs (*e.g.* von-Niessl-Hoffmeister's catalogue).

Another possibility evidently does not occur to Paneth—that our stellar universe itself, whence the hyperbolic meteors as judged by their velocities must come, may be not very much older than the solar system. Some time ago it seemed to be the general belief of the astrophysicists that the age of the stars and of the galactic system must be much greater than the age of the earth, being of quite different orders of magnitude. This was really only a belief, not more. From considerations of different kinds of intra-atomic supply of energy, or from the observed parallelism of the motions of stars in moving clusters, one may set certain values as an upper limit to the age of the stellar universe; but whether the stars of our present universe have really existed all this time is a different question; they may be just at the beginning of their evolutionary course. The obvious non-homogeneity of the galactic structure does not suggest that the mixing of its different constituents —clouds, clusters, moving clusters, widely separated in space pairs of

[1] A series of papers, the most recent being "Heliumuntersuchungen X," by F. Paneth and W. Koeck, *Zeits. für Phys. Chem.*, Festband, 145, 1931. Synopsis in *Zeits. für Electrochem.*, 1930, 727; in *Naturwissenschaften*, **7**, 164, 1931; in *Nature*, **125**, 490, 1930.

stars with parallel motion—has progressed very far. The so-called equipartition of energy in stellar velocities, alluded to by Jeans in estimating the age of the universe, has evidently nothing to do with the equipartition in the Maxwellian sense, because evidently it is incompatible with the real nonhomogeneity of stellar distribution and motions mentioned above. Stellar velocities seem to depend much more upon position in space and origin, than upon mass; the motions are highly systematical. Before equipartition of energy takes place, evidently all kinds of moving clusters and wide pairs of double stars must have been destroyed. From this standpoint the hypothesis of equipartition of energy in stellar velocities must be regarded as extremely artificial; at best, it perhaps may reflect some statistical state inherited from a time when the universe was much more close together than now.

A similar state of affairs may be observed with respect to our conceptions of stellar evolution: great intervals of time must necessarily be postulated for evolution to take place, without positive evidence that the stars really have changed. A star, losing its mass in the form of quanta of light, must decrease gradually in luminosity and mass, going through consecutive stages of evolution which may be now observed simultaneously in the different classes of spectrum and luminosity—classes which, on the conception of evolution, must represent stars of very different ages; if this conception is true, and if all the lost mass goes into radiation, the most generous source of stellar energy—annihilation of matter—must be assumed, in which case the lifetime of a star, or the time during which its mass decreases in the ratio $1 : e$, may be of the order of 5×10^{12} years for a dwarf like our sun, and "only" 5×10^{10} years for a supergiant. However, these are maximum ages; if scientists accepted these maximum estimates, it was perhaps the result of a psychological reaction after having been oppressed for some while by too short a supply of Helmholtzian gravitational energy. Moreover, we do not know whether annihilation of matter really takes place inside a star. Proceeding to the next most powerful source of intra-atomic energy, the formation of heavier elements out of hydrogen, we find the maximum ages in this case 5×10^{10} for the sun and 5×10^{8} for the supergiant. If we still wish to maintain the belief that stars which we observe now have undergone in their past a considerable evolutionary change, passing through stages represented at present by the more luminous and more massive classes, we must find another explanation for the change in mass which must have taken place, because the synthesis of elements out of hydrogen may produce a maximum decrease in the mass of 0.8 per cent only, which is quite insignificant compared with the actual range in stellar masses. We may assume in this case that the chief loss in mass takes place at the boundary of the atmosphere, through the effect of radiation pressure. However, this assumption appears to be very artificial; the loss of mass from the boundary must in some way keep pace with the evolution of the energy

sources in the interior of the star, a process which seems to be somewhat improbable, if not impossible.

On the other hand, if we assume a more recent origin for the present universe, all considerations on stellar evolution become mere theoretical speculations about what will happen to the stars in the far future. The stars have not had time yet to suffer any appreciable loss in their mass, with the exception, perhaps, of the supergiants; their stage of evolution is practically the same as it was soon after their creation. The observed variety in luminosity and spectrum is not the result of evolutional change, but is the reflection of initial conditions: mass and chemical constitution.

The low value for the age of the universe would be in good agreement with the observed recession of the spiral nebulae. Eddington and Lemaitre, in their considerations with respect to the "Expanding Universe," find time intervals for the evolution of the universe of the same order of magnitude as the intervals involved in the evolution of the earth. Be that as it may, if we regard the observed motions of the spirals as real, and trace the changes observed at present backwards, we find that a few thousand million years ago the universe was in a peculiar, more concentrated state, from which it started expanding, possibly as a result of some cataclysm. Hence, it is not far to the conclusion that the origin of the solar system was not very greatly separated in time from the origin of the universe itself. The puzzle of the occurrence of supergiants in globular clusters, which are as a rule coexistent with much fainter blue stars (a puzzle which according to Shapley[2] sets insuperable difficulties in the ordinary conceptions of stellar evolution), seems also to be explained in the most natural way if we assume that all the clusters are of recent origin, and practically of the same age, the relative ages of the different globular clusters differing perhaps by a few hundred millions of years or so.

There is an indirect method which has been applied by the writer,[3] to test different hypotheses as to the evolutional trend and relative age of the stars. The method is based on statistics of distances and magnitudes of double stars. While in the case of spectroscopic binaries tidal forces may have influenced the orbital elements, and the supposed fission of the originally single star might have taken place in recent times, it is probable that the more distant companions in visual double stars, the majority of which have not shown relative orbital motion since the time of their discovery, reflect more trustworthily the entire history of the stars. A secular decrease in the masses of the components will

[2] *Harvard Bulletin* 876, 14, 1930.

[3] *Tartu Observatory Publications*, **25**, 6, 1924. Kreiken, *Monthly Notices*, **90**, 306, 1930, deals with the same subject, but because he neglects the selection factor, depending upon distance, it is quite natural that he arrives at somewhat different results. His opinion that the discrepancy is due to the assumed absolute magnitudes is not right; statistics of double stars may be reliably done only with full account of the selection factors.

produce an increase in the average distance; the distance changes inversely as the mass. By changing all the distances in the same ratio, the frequency-function of the distances, if arranged according to the logarithm of the distance, will show a constant displacement along the log d axis; the decreasing mass will produce an outward displacement with time, the amount of the displacement giving the ratio in which the mass has changed. From a statistical discussion of 1162 double stars brighter than magnitude 6.5, after taking into account different kinds of selection, it was found that the frequency-functions for different classes of stars all showed certain common characteristic features, which made possible the determination of the relative displacements of the curves. The result of the comparison of the frequency-functions is given below:

	Dwarfs				
Spectrum and Luminosity Class	K (G5-K5)	G (F7-G4)	F (A5-F6)	A (B8-A4)	B (B0-B7)
Number of Double Stars	32	56	219	415	116
Observed Distance Ratio (relative displacement)	0.5	0.25	0.8	0.9	1.1
Expected Distance Ratio	2.5	1.8	1.3	0.9	0.5

	Giants		
Spectrum and Luminosity Class	G (F-G4)	K (G5-K4)	M (K5-M6)
Number of Double Stars	38	197	40
Observed Distance Ratio (relative displacement)	2.5	1.6	4.0
Expected Distance Ratio	0.3	0.6	0.3

The expected distance ratio is found with the aid of values of the probable masses, estimated from Eddington's mass-luminosity relation,[4] on the assumption of continuous evolution with decreasing mass; the distance ratio is relative to a certain average. A glance at the figures indicates that there can be no question of the dissimilarity between the two sets of data. The distance ratio increases with the mass, instead of decreasing with it; whatever the uncertainty of the observational data may be, it cannot change our principal conclusion: that the different luminosity classes cannot be regarded as successive stages of evolution of the same kind of objects. Stars of small mass could not have evolved from stars of large mass of the kind we observe now. Either the stars do not change in mass, or the time elapsed since their origin is too short for such a change. It thus seems certain that the stars cannot even approximately be members of the same chain of evolution; the differences in luminosity and spectrum we observe now are due to different initial conditions—mass and composition.

The following objection may be made to the method described above: in the course of time, close approaches with other stars will have the effect of stripping off the outer companions, the effect increasing with distance between the components and decreasing with mass. It is easy to see that on account of this effect the average distance of companions

[4] In this respect the data differ from those of the original paper in *Tartu Publ.*, **25**, 6, 1924.

with smaller mass will be smaller, and under certain conditions a distribution of distances similar to the observed one may result. For G dwarfs, to obtain the necessary effect, we should strip off about two-thirds of the companions at 1500 a.u. distance. With the present density of stars in space, the time required to strip off from the G dwarfs $1 : e$ fraction of companions at the effective distance of 1500 a.u. is found equal to 2×10^{12} years. Curiously enough this is almost identical with the maximum age estimated on the basis of annihilation of matter as energy source.

The improbability of the objection just mentioned, however, and the young age of the stars may be proved in another independent way, namely, from statistics of relative magnitudes of double stars, given in the paper already mentioned.[5] Let us apply the term "cooling" to the decrease of the luminosity of the star in the course of time, and let us measure the age of the star by the total decrease in luminosity since its origin. Assuming Eddington's mass-luminosity relation and the corresponding rate of cooling computed on the assumption of annihilation of matter and changing mass in the course of stellar evolution,[6] we find that the rate of cooling, expressed in magnitudes, decreases very fast with decreasing luminosity; that is, for a difference of 4.3 magnitudes between the two components, the brighter one will cool from thirteen to thirty-eight times faster than the fainter component. This will result in a certain shrinkage in the relative magnitudes with progressing age. An inspection of the observed frequencies of the differences in magnitude indicates that the relative age of the stars of the dwarf series from B to K is practically the same, with an uncertainty of a few tenths of a magnitude; the hypothesis of evolution from B to K would require a difference in the age corresponding to six magnitudes. Referring for details to the paper quoted above,[7] it is sufficient to say that the frequency function of the relative magnitudes of double stars disproves in the most categorical way any genetic relationship between the different classes of stars observable at present, and indicates a very recent origin for all our stellar universe. The similarity of the distribution of distances and magnitudes of double stars belonging to different spectral classes must be the result of similar laws which have governed their origin; the enormous dissimilarity which ought to be produced by evolution in the distribution of the relative luminosities in double stars is not revealed by the observational data.

Briefly, the universe—the parent—is not much older than its child, the earth. The perplexing results obtained by Paneth are not perplexing any more. Some of the meteorites he investigated might have come

[5] *Tartu Publ.*, **25**, 6, 1924.
[6] A. S. Eddington, *Monthly Noticcs*, **84**, 328, table VIII, 1924.
[7] *Tartu Publ.*, **25**, 6. Eddington's mass-luminosity relation was not considered there; but it is obvious that this relation gives the only law of cooling supported by observational evidence, and will hardly meet with any objections, as far as our rough estimates are concerned.

from interstellar space, being as young, or even younger than those belonging to the solar system. Although the observations of velocities of fireballs are not very accurate, it is hard to believe that *all* the hyperbolic velocities recorded are wrong; some of them must be real. Instrumental determinations of velocities of meteors, observed in Arizona by the Harvard-Cornell meteor expedition,[8] indicate preliminarily that from ten to thirty per cent of visible meteors are hyperbolic; we may expect that among big meteorites the fraction of hyperbolic objects is of the same order of magnitude, so that among Paneth's twenty-four samples the chances are pretty strong for finding several strangers from interstellar space.

To avoid the necessity of dealing with probabilities, it would be highly desirable to have a case of well determined velocity. Fortunately there exists one such case—the Pultusk stone shower of January 30, 1868. The hyperbolic velocity of this meteorite stands practically beyond question, as may be inferred from the careful discussion by Galle.[9] The conditions were especially favorable because the meteor was overtaking the earth, and the determination of velocity was a differential one. There were also two well trained observers and a great number of others; the real path is determined very well. The average observed velocity was 28 km/sec, corresponding to an average duration equal to 6.7 seconds, derived from twenty-six estimates; the heliocentric hyperbolic velocity is 57 km/sec, and to make it parabolic the duration should have been almost double the observed one; moreover, the best observers agree in assigning to the meteor even a shorter duration. Taking from Galle's list only the observations where the observer is mentioned personally by name (that is, omitting newspaper records, etc.), we find thirteen estimates of duration ranging from 2.5 to 8 seconds, with an average of 4.6 ± 0.2 seconds. This, together with the fact that the meteor suffered considerable deceleration, ending almost in a full stop at the end of its path, makes the interstellar origin of the Pultusk stones practically certain.

On the suggestion of Dr. Shapley, Professor Paneth undertook the determination of the age of some samples of this meteorite, and found the value about 500 million years[10]—even lower than the average for the iron meteorites. Thus, the low age of the stellar universe is strongly confirmed by this single, but highly significant fact.

The mere fact that the Pultusk stones were able to retain a certain amount of helium is an additional chance in favor of its extrasolar origin. Paneth's experiments[10] in heating the Pultusk stones indicate that they do not keep helium better than terrestrial rocks; at a temperature

[8] Preliminary report by H. Shapley, E. J. Öpik, and S. L. Boothroyd in *Proc. Nat. Acad. Sci.*, **18**, 16, 1932. Also, *Harvard Reprint* 74.

[9] T. G. Galle, Ueber die Bahn des am 30, Januar 1868 beobachteten und in Pultusk im Königreiche Polen als Steinregen niedergefallenen Meteors. Breslau, 1868.

[10] Communicated by Professor Paneth in a letter to Dr. Shapley.

of 265° C a sample lost six per cent of its helium in three hours. An extrapolation of Paneth's data indicates that the "lifetime" of occluded helium in the Pultusk stones at 0° C, the probable temperature of a stone at the distance of the earth from the sun, may range from four to 40,000 years; at 100° C the estimated lifetime is from two months to two years. Considering now that the meteor if belonging to the sun must have approached it many times and must have been exposed to temperatures of 0° C or higher for a total duration of thousands of years in *vacuo*, we should really expect that such a meteorite could retain only a small fraction of the total amount of helium produced during all the time of its existence. The quantitative laws which govern the escape of occluded helium must be analogous to those determining the escape of heat; the lifetime will be approximately proportional to the square of the linear dimensions (radius, or thickness of the layer, etc.). Now if compact masses of terrestrial rocks lose under high pressure as much as fifty per cent and more of their helium content during geological ages, a small stone of some 10 cm diameter at zero pressure would lose the same amount within a few years, the temperature being the same. What the escape of gases from heated meteors is like may be judged from the phenomena of cometary tails and gaseous envelopes; the gases observed there are much more firmly held by solid bodies than is helium, which cannot be chemically bound.

Radioactive estimates of the age of meteorites and of the earth are supposed to give the time elapsed since these bodies were in a hot (probably liquid) state. Now, from the standpoint of evolution, the stage of the solid existence of these bodies may represent only a small fraction of all their life; that is, we cannot prove that the liquid state was not preceded by a solid state of the same individual body. In other words, the heating which led to the loss of helium from meteorites, or to the mixing of the lead in the rocks, might have been a temporary, or even a periodical event, in which case the life of the individual body might have been much longer than has been estimated.

That this is highly improbable, at least in the case of the earth, may be shown by the following considerations.[11] Assuming that all the lead in the earth's crust is the product of disintegration of thorium and uranium, and knowing the relative abundance of these elements in the crust, we may calculate the time necessary for the formation of the given amount of lead. The time so obtained will be considerably overestimated, because some of the lead may have originated independently of any radioactive process, and also because the proportion of lead in the earth's crust relative to the more heavy radioactive elements is likely to be greater than the proportion in the earth as a whole.

From the data of Clarke and Washington,[12] confirmed by T. and W.

[11] Compare H. N. Russell, *Proc. Roy. Soc., London*, **99**, 84, 1921. Here more recent data are used.

[12] *U. S. Geol. Survey, Prof. Paper* 127, 1924.

Noddack,[13] the average abundance of lead, thorium, and uranium in the earth's crust is 8.0×10^{-6}, 2.5×10^{-5}, and 5.0×10^{-5} respectively. The average atomic weight of lead, 207.2, implies that sixty per cent of it must be the isotope thorium-lead (208). This gives the ratio thorium-lead : thorium equal to 0.192. With the value of the half period of thorium of 2.2×10^{10} years, this yields a maximum age of 6×10^{9} years. This is the maximum interval of time during which the laws of stability of thorium and lead (208) atoms were the same as they are now. Before this time, certain conditions must have existed unfavorable to the accumulation of lead; either lead was destroyed, or thorium did not exist, being built up later; or a reverse process of building thorium out of lead was going on. With the present state of our knowledge, it seems likely that only at the very high temperatures of stellar interiors, the stability of the elements may be different from what it is under the conditions possible in our laboratories. A body of such small mass as our earth could hardly attain a central temperature sufficiently high for atomic transmutations without blowing up by radiation pressure. Thus, we conclude that less than 6000 million years ago the earth must have formed part of a larger body, the central temperature of which was high enough to invert certain radioactive processes. Taking into account the very generous overestimate, we find that the time elapsed since the beginning of the individual existence of the earth until the formation of the solid crust could not be much greater than the age of the crust itself; this points to a rapid course of evolution in the beginning. It may be added, that the ratio of uranium-lead to uranium indicates a maximum age of 3×10^{10}, but because this limit is covered by the more narrow thorium limit, it need not be further considered.

The data for meteorites are too scarce at present to allow reliable estimates of the same kind. From preliminary data by Noddack and Paneth relating both to thorium and uranium, estimates of a maximum age for the lead atoms of 2×10^{10} y. in stone meteorites, and 4×10^{10} y. in iron meteorites, are obtained. These limits are not so narrow as in the case of the earth; but the overestimate must be large, because for these bodies probably formed in the outer regions of space the lighter atoms of lead are likely to show a greater selective abundance than the heavy parent atoms. Another possibility, namely that of a continuous building up of elements in space, as well as in the earth's crust, by the action of cosmic rays, or by some other unknown source of energy of high concentration, cannot change our estimate as to the age of the earth; but for meteorites, an assumption of a constant equilibrium concentration of uranium and thorium, instead of an exponential decrease in the course of time, would lead to much higher estimates. Such a picture, however, appears highly improbable.

[13] *Naturwissenschaften*, **18**, 757, 1930.

Concluding, we may say that the combined evidence presented by meteorites, by statistical data relating to wide double stars, by the distribution of stellar luminosities in globular clusters as pointed out by Shapley, and by the observed recession of spiral nebulae (whatever the interpretation for it may be), once we assume that the recession is real, all this evidence points to an age of the stellar universe of the same order of magnitude as the currently accepted age of the solar system: not much more than 3000 million years.

I wish to express my thanks to Dr. Shapley, at whose suggestion the present review was undertaken.

HARVARD COLLEGE OBSERVATORY, CAMBRIDGE, MARCH 16, 1932.

Two Giant Planetaries

The Nebulae N. G. C. 6960 and 6992-5 and the Great Outer Nebulosities of Orion

By C. D. PERRINE

N. G. C. 6960	α	$20^h\,42^m$	δ	$+30°\,21'$ (1900)
N. G. C. 6995		$20\ 53$		$+30\ 50$ (1900)

N.G.C. 6992-5 in Cygnus is known as the "Network" nebula. It is unique among the nebulae, no other as large and striking of its type being known. N.G.C. 6960 distant nearly three degrees shows a somewhat similar filmy structure, but is more condensed (Plate II).

Ever since its photographic observation by Keeler with the Crossley reflector in 1899, 6995 has been an enigma as to its origin. It has the appearance of a mass of flames, but where did it come from and how? Of all the nebulae it has been to me the most fascinating because of its beautiful structure and its absolute mystery.

I have not been able to free my mind from the idea that in some undiscovered manner it had actually been ejected in the course of some titanic outburst. But no evidence of any such happening or possible source within a reasonable distance could be traced. I am unaware of any attempt to explain the origin or forms of these objects.

Recent work on the planetary nebulae, however, has suggested that the two nebulae in question are the remains of a single outburst and that together they form a planetary easily the giant of the class.

These two nebulae are too far apart to be photographed in the same field and plate with the reflectors now devoted to such work. The photographs by Barnard with a portrait lens, however, show both together and a large area of sky about them[1] (Plate III).

No other nebulae are to be found on these photographs. This fact justifies the suspicion, considering their forms, which are concave

[1] Publications *L.O.*, 11, Plates 79 and 80.

towards each other, that they may be related, and that they may be the remains of an outburst such as originates the planetary nebulae.

Examination of the photographs, especially those taken with the reflectors at Yerkes, Lick, and Mt. Wilson observatories, shows not only that they are concave toward each other but that the structures on the convex sides or outsides of both are different from the concave or insides. They are much better defined on the outside and the details of both are in general similar to many of the ring-form planetaries. Indeed if we compare them with the Lyra planetary, for example, the similarity of the main features is striking.

The nebulae 6960 and 6995 would occupy the poles, or minor axis, the major axis being in position angle 160°. Barnard calls attention to faint nebulosity in the region between them some of which is well defined. There is no indication of nebulosity *outside* these nebulae to the east or west. 6960 is on the edge of a dark streak among the stars in that region nearly in the direction of the assumed major axis.

The appearance of 6960 and 6995, however, is such as to suggest a relationship to a central star or stars between them, rather than that 6960 is merely a bright edge to the dark streak. 6995 especially has the appearance of streams having been blown out from some central point. It is more likely that the dark streak is in reality absorbing (cosmic) matter and that it was some of that which coming into collision through gravity with the interior stars caused the outburst and the consequent formation and ejection of the nebulae.

If these nebulae were formed by ejection it is of course desirable to find the stars from which they emanated. The assumption that they emanated from a central star is justified not only by their appearances but by the essentially universal fact of a central star in all planetaries.

As bright lines have been detected by several observers,[2] in the matter of spectrum as well as form these two nebulae are allied to the planetaries rather than to such nebulosity as that about the Pleiades for example.

If these two nebulae are ejections from a star or stars, these might be expected to be of B or A type. The nuclei of the planetaries are almost invariably of Wolf Rayet or early O type. But owing to the sizes of 6960 and 6995 and distances from probable centers of disturbance together with the apparent scarcity of nebulous matter within, a later type than Wolf-Rayet would be expected. No very bright stars are near these nebulae either between them or in the region outside.

The star +30° 4167 Mag. 4.3, 52 Cygni, near 6960 is of K type from which it is presumed, as well as from its position, to have no direct connection with the nebulosity although its small proper motion indicates considerable distance.

[2] Wolf, *Astr. Nach.*, **180**, 152, 1909; Frost & Alden, *Pop. Astron.*, **22**, 136, 1914; Slipher, *Lowell Obs. Bulletin*, 2, 59, 1914; Moore & Green, *L.O. Publications*, **13**, 155, 1918.

There are, however, four stars of about 7th magnitude, with spectra from B9 to A5, whose positions between the nebulae are such as to suggest the possibility of their being concerned, perhaps all of them, as certain features of the nebulosity are better explained on that assumption. These stars are

Draper	α h m	δ ° ′	Mag.	Spec.
198597	20 46.3	+30 59	7.7	A0
198626	20 46.5	+30 32	6.75	A2
199042	20 49.4	+30 34	7.76	B9
199055	20 49.5	+31 15	6.90	A5

It does not seem desirable at present to discuss further possible relationships to these stars. Future observations may disclose structure of the nebulosity in the region between 6960 and 6995 and spectroscopic or other evidence which will throw much needed light on the matter. For example the proper motions and radial velocities will disclose whether any intimate relationship exists among the four stars or whether perchance they are also separating after the outburst which is supposed to have ejected the nebulosity. If these two objects in reality constitute a planetary nebula, their radial velocities may be expected to be rather small and negative. As already suggested 6960 may be related to the dark region bordering it if this dark region is one of obscuring matter.

There does not seem to be any such possibility in the case of 6995—it is satisfactorily explained on the hypothesis of ejection from a stellar encounter with cosmical matter.

On the whole the evidence is sufficient to justify the tentative assumption that the two nebulae 6960 and 6995 have been formed in a manner essentially similar to the typical planetary. It is not necessary to assume that such a mode of formation must produce entire symmetry.

In this connection the nebulae N.G.C. 1499 near ξ Persei is of especial interest. ξ Persei is of Oe5 type, Mag. 4.3, and the nebulosity is *wholly on one side of the star*. Its form is such as to leave little doubt that it is closely related to the star. I have not been able to find any observation of the spectrum of this nebulosity.

These characteristics of 1499 which are typical of such nebulosities are confirmatory of the conclusion that the K-type star 52 Cygni has no direct connection with the origin of the nebula 6960-6995.

CORDOBA, SEPTEMBER 24, 1929.

Note added November 21, 1931.

The foregoing article was laid aside awaiting the preparation of photographs for illustration. Due to pressure of other work these could not be completed as planned. Recently has appeared an article by Frank E. Ross[3] in which he also suggests that these nebulae form a physical system.

The excellent photographs accompanying Ross's article and those

[3] *Ap. Journal*, **74**, 85, 1931.

with the 60-inch reflector at Mt. Wilson by Ritchey[4] make unnecessary further illustration beyond that herewith showing the position of the stars suspected of being connected with the outburst as well as the general features of the nebulae which has been copied from Barnard's photograph in Vol. 11 of the *Publications of the Lick Observatory*.

Recently a photograph of the Orion nebulosities has come into my hands which not only resembles the Cygnus nebulae in the essentials but throws strong light on the origin of both (Plate III).

This photograph was taken at the Yerkes Observatory by Dr. F. E. Ross, on January 6, 1927, with a Ross-Fecker lens having an aperture of 3 inches and a focal length of 21 inches; the exposure time was five hours. The field covered (8x10 plate) is therefore over $21^\circ \times 26^\circ$ and shows with an exposure of five hours outlying nebulosities well upon a much larger area of sky. On that account their forms and relationships are fairly obvious.

These outer nebulosities are faint but the general oval form is obvious. The east and west nebulosities are brighter than the north-south regions. The east nebulosity is brightest of all. The general similarity to the Cygnus group and to some of the planetaries is obvious—the same greater brightness near the minor axis, and faint extensions along the major axis.

From earlier and much less perfect photographs it was concluded by some astronomers that these exterior nebulosities in Orion were of spiral form. These recent photographs, however, show that conclusion to be erroneous.

In the Orion group we have the central disturbances so obvious that there can be no doubting either the source or the cause. The source is not single, but there are two, the Zeta region and that of the Great Nebula around Theta Orionis. Even the division of both east and west groups of nebulosity into two groups each is well marked and their obvious relation to the separate sources needs no demonstration.

The Cygnus group can no longer be considered the giant planetary as that of Orion is of ten times the area—being no less than 10° east-west by 13° north-south.

As a result of the evidence herein presented I have no hesitancy in concluding that both the Cygnus and Orion objects are planetaries in all essentials—the only real difference between these and the small planetaries being the larger number of stars concerned and the greater scale of outbursts.

The Orion object especially is such strong evidence that who can doubt that these objects have been formed as the result of encounters of streams of cosmical matter with stellar bodies? No other hypothesis seems tenable.

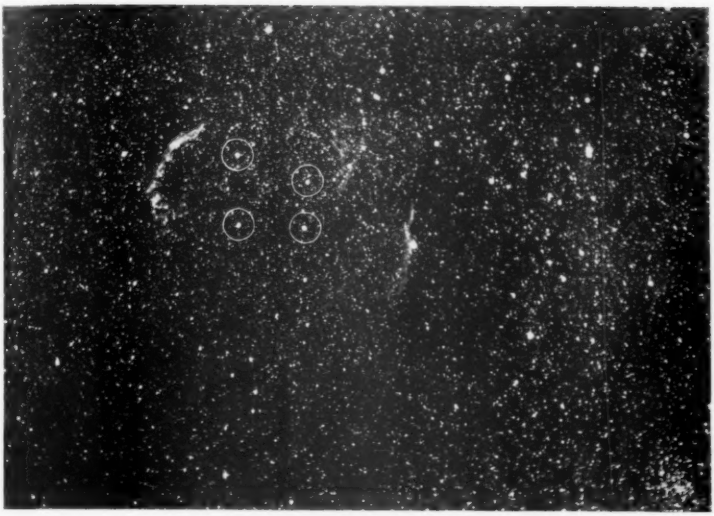
By what means can we get a glimpse of these objects a thousand

[4] L'Evolution de l'Astrophotografique et les Grands Telescopes de l'Avenir.

PLATE II

A Part of Nebula N.G.C. 6960 in Cygnus.

PLATE III



REGION OF NEBULA 6992-5 AND NEBULA 6960 IN CYGNUS.
(The circles indicate the four stars suspected of being the origin of the nebulae.)

THE NEBULOSITIES IN ORION.
POPULAR ASTRONOMY, No. 402.

years hence to determine their proper motions? And who will sacrifice a year's (or a lifetime's) work toward getting radial velocities of these evanescent objects in their different parts?

The structural details alone in the Orion region are worthy of extensive study.

How can we preserve the details of position and brightness of today's photographs with sufficient accuracy for use a thousand years hence?

Note added May 13, 1932.

Campbell and Moore, in Vol. 13 of the *L. O. Publications*, give a large number of determinations of radial velocity in different parts of the Orion Nebula. It is of interest to examine these velocities in connection with the hypothesis that the Trapezium nebula (which has been called heretofore simply the "Orion" nebula) in connection with the outer nebulosities form a giant planetary.

As those investigators found in their work on the planetaries, and which is also indicated by theory, such objects should be in rotation about their minor axes. Hence if the Orion object is really of a planetary nature, the radial velocities might be expected to vary along the major axis which is roughly in position angle 165°-345°. If we take the 42 determinations of Fig. 16, omitting those 6 which are in the bright inner region of the Trapezium, five of which are abnormally high for that region, due perhaps to physical action related to that core, and classify these 42 into five bands approximately 20″ wide parallel to the minor axis, we find a fairly consistent decrease (of positive velocity) from south to north, as in the following table.

Band		No. of Values	Radial Velocity	
1		6	+18.2 km	South
2		12	+18.0	
3	Central	8	+17.4	
4		11	+16.5	
5		5	+14.2	North

The consistency within the different groups is sufficient to confirm the general change shown in the table.

These results indicate a rotation about the minor axis, the northern part approaching and the southern receding with respect to the central portion. It is to be observed that the central band gives the same velocity as the *mean* of all determinations of this Trapezium nebula.

This fact further strengthens the conclusion that the differences indicate rotation. The above results cover a radius of 1′ from the Trapezium.

Fig. 19 gives the results of their observations covering a larger area of the same nebula—over a radius of 8′ from the Trapezium, and in a different form—the *excess* of velocity over the *mean*.

When treated in a similar way these results also show differences in the same sense as those above, as is here shown.

	Band	No. of Values	Excess Radial Velocity	
	A	5	+4.4 km	South
Central	B	10	−0.8	
	C	11	−1.5	North

The large positive value in the detached mass was omitted. An unusual proportion of zero values exists in the north group.

The above velocities refer only to the Trapezium region. What the situation as to the Zeta Orionis region may be, which is also involved, is not known, as I know of no determinations in that region.

In so far as the Trapezium region is involved we may conclude that the radial velocity determinations are in accord with the conditions to be expected in a typical planetary.

The amount and high quality of the data leave no reasonable doubt as to the reality of the observed differences. I have been unable to find any velocity observations of the Cygnus nebulae.

The Rittenhouse Bicentenary Celebration

(1732-1932)

By H. B. RUMRILL*

On April 8 and 9, 1932, there was celebrated in Philadelphia the two-hundredth anniversary of the birth of the famous American astronomer, David Rittenhouse.

Rittenhouse was not only an able mathematician and astronomer, but an instrument maker and clock maker of exceptional ingenuity. His instruments and clocks are the prized possessions of the chosen few into whose hands they have descended, including the magnificent clock formerly owned by the famous journalist George W. Childs, which now belongs to the Drexel Institute in Philadelphia.

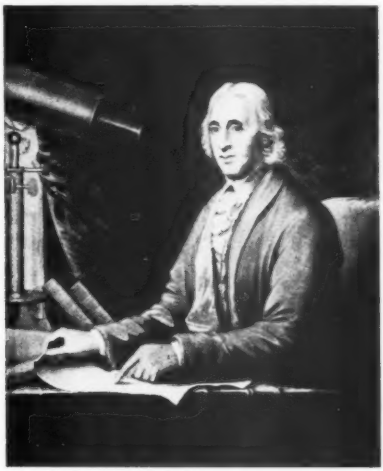
In his early life he was employed in fixing the boundary lines of the State of Pennsylvania, as well as the northern boundary of the State of New Jersey and that which separates the States of New York and Massachusetts. With his own hands he constructed the instruments with which this work was performed and it is noteworthy that the boundaries which he fixed were verified by Mason and Dixon and found to be accurately drawn. The curved line which separates Delaware from Pennsylvania was established by Rittenhouse as the arc of a circle whose centre is located at New Castle, Delaware—a distance of 12 miles.

Dr. Maurice J. Babb, Professor of Mathematics at the University of

*President of the Rittenhouse Astronomical Society.

Pennsylvania, in a leaflet published by the Rittenhouse Astronomical Society (which takes its name from Rittenhouse), entitled *Who was David Rittenhouse?* records that "In 1763 Rittenhouse surveyed the boundary of Delaware and Pennsylvania with instruments of his own making. This provided the cornerstone for Mason and Dixon who, in 1766, ran their line for 160 miles. Rittenhouse extended this line in 1779 and at earlier and later dates he laid the entire boundary of Pennsylvania."

He was born April 8, 1732, in the "New House" at the upper end of Lincoln Drive, Philadelphia, and spent his boyhood and early manhood



DAVID RITTENHOUSE
1732-1796

at Norriton, near Norristown, Pennsylvania, where, at the age of twelve, a bequest of tools and mathematical books and manuscripts from his Uncle David led him to the vocation of mechanics and mathematics. By 1749 he had established himself as a clock maker. His clock making was in no sense conducted on the basis of commercial manufacture, but each clock which came from his painstaking hands was an individual creation. The cases for these clocks were the work of various cabinet makers, his own efforts extending to the very beautiful mechanism, of superior accuracy.

His mechanical genius was at its zenith in the construction of the renowned Orrery in the possession of the University of Pennsylvania. Of the two instruments of this kind made by Rittenhouse, that mentioned is the only one known to be in existence. A description of this Orrery forms part of Section 1 of the Mathematical and Astronomical

Papers published in the *Transactions of the American Philosophical Society* of the year 1771, and is reproduced in full, as follows:

A description of a new ORRERY, *planned, and now nearly finished, by* David Rittenhouse, *A.M. of* Norriton, *in the county of* Philadelphia. *Communicated by Dr.* SMITH.

THIS *machine* is intended to have three *faces*, standing perpendicular to the horizon: That in the front to be four feet square, made of sheet brass, curiously polished, silvered and painted in proper places, and otherwise ornamented. From the center arises an axis, to support a gilded brass ball, intended to represent the *sun*. Round this ball move others, made of brass or ivory, to represent the *planets*: They are to move in elliptical orbits, having the central ball in one focus; and their motions to be sometimes swifter, and sometimes slower, as nearly according to the true law of an equable description of areas as is possible, without too great a complication of wheel-work. The orbit of each planet is likewise to be properly inclined to those of the others; and their *Aphelia* and *Nodes* justly placed; and their velocities so accurately adjusted, as not to differ sensibly from the tables of astronomy in some thousands of years.

FOR the greater beauty of the instrument, the balls representing the planets, are to be of a considerable bigness; but so contrived, that they may be taken off at pleasure, and others, much smaller, and fitter for some purposes, put in their places.

WHEN the machine is put in motion, by the turning of a winch, there are three indexes, which point out the hour of the day, the day of the month, and the year, (according to the *Julian* account) answering to that situation of the heavenly bodies which it then represented; and so continually, for a period of 5000 years, either forward or backward.

IN order to know the true situation of a planet, at any particular time, the small sett of balls are to be put each on its respective axis, then the winch to be turned round 'till each index points to the given time; then a small *Telescope*, made for the purpose, is to be applied to the central ball, and directing it to the planet, its longitude and inclination will be seen on a large brass circle, silvered, and properly graduated, representing the *Zodiac*, and having a motion of one degree in 72 years, agreeable to the precession of the *Equinoxes*: So likewise by applying the telescope to the ball representing the *Earth*, and directing it to any planet, then will both the longitude and latitude of that planet be pointed out (by an index, and graduated circle) as seen from the earth.

THE two lesser *Faces* are four feet in heighth, and 2 feet 3 inches in breadth: One of them represents and exhibits all the appearances of *Jupiter*, and his satellites, their eclipses, transits and inclinations: Likewise all the appearances of *Saturn*, with his ring and satellites. And the other represents all the phænomena of the *Moon*, particularly the exact time, quantity, and duration of her eclipses, and those of the *Sun*, occasioned by her interposition; with

a most curious contrivance for exhibiting the appearance of a *Solar Eclipse* at any particular place on the earth: Likewise the true place of the *Moon* in the signs, with her latitude, and the place of her *Apogee* and *Nodes*, the *Sun's* declination, equation of time, &c. It must be understood that all these motions are to correspond exactly with the celestial motions, and not to differ some *Degrees* from the truth, as is common in orreries.

THE whole may be adjusted to, and kept in motion by, a strong *Pendulum Clock*, nevertheless, at liberty to be turned by the winch, and adjusted to any time, past or future.

N. B. THE above machine is to be supported by a mahogany case, adorned with foliage, and some of the best enrichments of sculpture. The part containing the mechanical astronomy of the *Moon*, has been sometime finished, and is found perfectly to answer, by many trials already made of it. The remainder of the work, is now almost compleated. The clock part of it may be contrived to play a great variety of *Music*.

The transit of Venus which occurred June 3, 1769, was observed by Rittenhouse with instruments specially designed by himself, and he was assisted by Dr. William Smith, first Provost of the University of Pennsylvania, and by John Lukens, Surveyor General of Pennsylvania. His observations corrected the Sun's parallax from 10 seconds to 8.805 seconds (remarkably close to the value now accepted—8.803 seconds), putting the Earth some 20 per cent farther from the Sun than had previously been supposed to be the distance. From the *Transactions* referred to, Mr. Rittenhouse's account of the contacts is appended:

AT 2^h. $11'$. $39''$ per clock, the Revd. Mr. *Barton* of *Lancaster*, who assisted me at the Telescope, on receiving my signal, as had been agreed, instantaneously communicated it to the counters at the window, by waving a handkerchief; who walking softly to the clock, counting seconds as they went along, noted down their times separately, agreeing to the *same second*. And three seconds sooner than this, to the best of my judgment, was the time when the least impression made by *Venus* on the Sun's limb, could be seen by my Telescope.

WHEN the Planet had advanced about one third of its diameter on the Sun, as I was steadily viewing its progress, my sight was suddenly attracted by a beam of light, which broke through on that side of *Venus* yet off the Sun. Its figure was that of a *broad-based pyramid;* situated at about 40 or 45 degrees on the limb of Venus, from a line passing through her center and the Sun's, and to the left hand of that line as seen through my Telescope, which inverted. About the same time, the Sun's light began to spread round *Venus* on each side, from the points where their limbs intersected each other.

As *Venus* advanced, the point of the Pyramid still grew lower, and its circular Base wider, until it met the light which crept round

from the points of intersection of the two limbs; so that when half the planet appeared on the Sun, the other half yet off the Sun was entirely surrounded by a semicircular light, best defined on the side next to the body of *Venus*, which continually grew brighter, till the time of the internal contact.

IMAGINATION cannot form any thing more beautifully serene and quiet, than was the air during the whole time; nor did I ever see the Sun's limb more perfectly defined, or more free from any tremulous motion; to which his great altitude undoubtedly contributed much.

WHEN the *internal contact* (as it is called) drew nigh, I foresaw that it would be very difficult to fix the time with any certainty, on account of the great breadth and brightness of the light which surrounded that part of *Venus* yet off the Sun. After some consideration, I resolved to judge as well as I could of the coincidence of the limbs; and accordingly gave the signal for the *internal contact*, at $2^h.\ 28'\ 45''$ by the clock and immediately began to count seconds, which any one, who has been accustomed to it, may do for a minute or two, pretty near the truth. In this manner I counted no less than $1'\ 32''$ before the effect of the atmosphere of *Venus* on the Sun's limb wholly disappeared; leaving that part of the limb as well defined as the rest. From this I concluded that I had given the signal for the *internal contact* too soon; and the times given by the other observers at *Norriton* confirm me in this opinion.

In the year 1770 Rittenhouse moved to a residence at the southeast corner of Seventh and Arch Streets, and soon after constructed an octagonal brick observatory on the northwest corner. The activities of this pioneer astronomer of the New World were not, however, confined to the work in which astronomers are more particularly interested. He was a serious minded student, a master of the German and French languages, and an ardent patriot, the friend of Benjamin Franklin and of Washington. In his "Notes on Virginia," 1782, Thomas Jefferson said of him, "We have supposed Mr. Rittenhouse second to no astronomer living; that in genius he must be the first, because he is self-taught." Like the late John Alfred Brashear, his talents led him into the service of his fellow men.

For the purpose of this article I can not do better than quote from Dr. Babb's brief biography in the leaflet already referred to, as follows:

> Rittenhouse was elected Secretary of the American Philosophical Society in 1771, Vice-President in 1790 and President, succeeding Franklin, in 1791. In 1796 he was succeeded by Thomas Jefferson. He was made a Fellow of the Boston Society of Arts and Science in 1782 and a Foreign Member of the Royal Society of London in 1795. He received the degrees of M.A. from Pennsylvania, 1767; Princeton, 1782; William and Mary, 1784; and Doctor of Laws, Princeton, 1789. From 1779 to 1782 he was Professor of Astronomy and Vice Provost of the University of Pennsylvania, at a sal-

ary of 400 pounds, and trustee thereafter. Besides constructing his ingenious clock and the renowned Orrery, Rittenhouse first used spiders' thread for cross-hairs in his telescope and he invented the collimating telescope in 1785. Many of his papers will be found in the first volumes of the American Philosophical Society Proceedings. In the Society's historic building adjoining Independence Hall, Philadelphia, some of his astronomical instruments are still displayed. It is interesting to note that, though engaged in public work, he published seventeen papers from 1780 to 1796, on optics, magnetism, electricity, meteors, logarithms, and astronomical observations, besides translating Lessing's "Lucy Sampson, or The Unhappy Heiress," from the German and the "Idylls of Gesner" from the French.

After 1763, besides his ordinary vocation, he was on various commissions on waterways and turnpikes. In 1775 he was ordered to prepare molds for iron clock-weights to replace lead ones, to survey the Delaware for fortification, and to test and rifle cannon. As Vice-President of the Committee of Safety he issued its proclamations. He succeeded, in 1776, to Franklin's seat in the State Assembly, was a member of the First Constitutional Convention of Pennsylvania, a member of the Board of War and of the Council of Safety, State Treasurer, 1777-1789, and First Director of the U. S. Mint, 1792-1795.

He died June 26, 1796, and was first buried under his observatory at 7th and Arch Streets. Six months later he was eulogized at the First Presbyterian Church by Benjamin Rush before the President and both Houses of Congress, both Houses of Legislature, the diplomatic corps and the various honorable bodies of his own city. Later his body was removed to old Pine Street. In 1878 it was borne to North Laurel Hill Cemetery. From this beautiful spot one can look over the Schuylkill to the forgotten and desecrated ruins of Provost Smith's Mansion at the Falls of Schuylkill, and meditate on the evanescence of fame.

The Rittenhouse celebration began on the afternoon of April 8, very fittingly, at the headquarters of the American Philosophical Society, 104 South Fifth Street, Philadelphia, a notable contribution being that by Dr. Annie J. Cannon of Harvard Observatory, her estimate of the worth of Rittenhouse being much applauded. Interesting papers were read by Russell Duane of the Philadelphia Bar, a direct descendant of Rittenhouse's friend Benjamin Franklin, and by Dr. Josiah H. Penniman, Provost of the University.

A dinner was given the same evening at the Pennsylvania Historical Society, 13th and Locust Streets, attended by many notable men and women of the city and by representatives of many learned societies.

The principal feature of the third session, Saturday afternoon, April 9, at Scottish Rite Temple, Broad and Race Streets, was the reading by Dr. Babb of a paper outlining Rittenhouse's life and achievements; while the fourth session, held in Houston Hall of the University on the

evening of that day, was presided over by John K. Rittenhouse, of the same ancestry as David Rittenhouse. At this session the following papers were read:

Paper Making at Time of Rittenhouse Paper Mill . . . . . Mr. Grellet Collins
American Pulp and Paper Association

The Astronomical Work of Rittenhouse . Prof. W. Carl Rufus
University of Michigan

The Rittenhouse Diffraction Grating . . Dr. Thomas D. Cope
University of Pennsylvania

A Fire Ball Observation . . . . . Dr. Charles P. Olivier
Director, Flower Observatory

Rittenhouse Clocks . . . . . Mr. George Eckhardt

The Transit of Venus . . . . . Mr. James Stokley
Associate Director, The Franklin Institute Museum

The Latitude Work of Rittenhouse . . Prof. John H. Pitman
Swarthmore College

The Orrery . . . . . Dr. Maurice J. Babb
University of Pennsylvania

Rittenhouse and His Contemporaries in the Royal Society . . . . . Mr. Frederick E. Brasch
Secretary, History of Science Society

The entire celebration was successfully conducted under the auspices of The American Philosophical Society, The Franklin Institute, The Historical Society of Pennsylvania, The Rittenhouse Astronomical Society, and the University of Pennsylvania.

It is thought worthy of note that the quotations dealing with the orrery and the transit reproduce faithfully the spelling and certain typographical peculiarities of the original; omitting only references to engravings, etc.

PHILADELPHIA, PENNSYLVANIA, APRIL, 1932.

David Rittenhouse, Pioneer Variable Star Observer

By JOHN H. PITMAN

At the beginning of the eighteenth century only four variable stars were known, viz: Mira Ceti, Algol, R Hydrae, and Chi Cygni. Near the end of the century Koch discovered the variability of R Leonis, two years later in 1784 Goodricke discovered that the light of Delta Cephei and Beta Lyrae varied, and determined their periods. During the same year Goodricke's friend Pigott discovered Eta Aquilae. The next year the latter found that R Coronae and R Scuti also varied in brightness. And in that same year, 1785, W. Herschel observed that Alpha Herculis changed its brightness in an irregular manner.

It has been the writer's privilege to examine two note books of David

Rittenhouse. The earlier one containing entries on many subjects is the property of Dr. Maurice J. Babb of the University of Pennsylvania. The upper portion of one of the pages in this book is ruled in pencil in rectangular coördinates on a scale of approximately a centimeter per degree. On this eight stars of Aquila are plotted and lettered. The stars marked are Alpha, Beta, Gamma, Delta, Eta, Mu, Nu, and Xi. Alongside of Eta Aquilae is written in ink the word variable. On the preceding page is a similar diagram with Alpha, Beta, Gamma, and Delta Lyrae marked with Beta designated as variable.

In various portions of the book are fourteen observations of brightness nine of which occur in the meteorological notes and five are written in other places. The first observation written in the right hand column of the meteorological diary after date of Sept. 30, 1789 is "*b* and *c* nearly equal." There are three stars indicated as a, b, c. From the grouping, I would assume *a* is Beta, *b* is Eta, and *c* is Mu Aquilae. "Oct. 1, 1789 8.15 *b* seems quite equal to *a*."

From here on the designation of the stars by letters is dropped and the variable is referred to as the star in the point of the triangle. The other observations I have arranged chronologically as follows:

Oct. 26, 1789 9.30 equal to the least;
Oct. 28, 1789 9.30 much bigger than the least;
Dec. 14, 1789 at 8 evening, the changeable star in the triangle certainly less than the least;
Aug. 14, 1790 8.30 Star in the point bigger than the biggest;
Aug. 30, 1790 at 9 star equal to biggest (At edge of book, some letters missing);
Sept. 23, 1790 at 10 night star in the point much less than the biggest;
Sept. 24, 1790 star small;
Oct. 31, 1790 at 9 evening, the star small again;
Nov. 7, 1790 at 6 evening, nearly the same size;
Dec. 10, 1791 at 5.30 variable star appears equal to the largest in the triangle and appears soon after daylight was gone and long before the smallest star (This date was originally Dec. 9 and 10 was subsequently written over the 9);
Dec. 24, 1790 6.30 variable less than the least;
Jan. 14, 1792 Star in the point of the triangle evidently much less that the least of the others at 7.35.

The second book is "Meteorological Observations by David Rittenhouse 1792" in the Library of the American Philosophical Society. In this are twenty-four more observations.

Aug. 29, 1792 At 8 evening, star in the point of the triangle certainly brightest of the three.
Oct. 22 and 23, 1792 star in the point certainly the brightest of the three.
Oct. 24, 1792 sensibly less.
Oct. 25, 1792 at 9 not bigger than the smallest.
Oct. 26, 1792 nearly the same.
Oct. 27, 1792 hazy.
Nov. 2, 1792 nearly as big as the biggest.
Nov. 3, 1792 much bigger than the least but less than the biggest.
Nov. 12, 1792 at 6 biggest of the three.
Nov. 16, 1792 at 6 certainly the least of the three.
Nov. 17, 1792 at 8 bigger than the least.

Aug. 29, 1793 star in the point much bigger of the three at 9 evening.
Nov. 2, 1793 at 9 variable star the least of the three very sensibly.
Dec. 18, 1793, Wed. variable star very small at 8.
Dec. 19, 1793, Thurs. variable star largest.
Dec. 22, 1793, Sun. variable star least.
Dec. 28, 1793, Sat., variable star very small.
Dec. 29, 1793, Sun., variable star very small.
Jan. 4, 1794, Sat., variable star something bigger.
Jan. 6, 1794, variable star small.
Jan. 7, 1794, Tues., variable star smallest.
Jan. 16, 1794, Thurs. variable star between the two in size.
Jan. 26, 1794, Mon. variable star once more large.
Dec. 14, 1794 Sun. Variable star bright.

These observations all preceded the paper by W. Herschel in the Philosophical Transactions 76, 1796 "On the method of observing the changes that happen to fixed stars." We also recall that these observations preceded by a half century Argelander's Neue Uranometrie in which he writes: "All the star charts which we possess up to the present time are lacking in two important respects: The magnitudes of the stars depend upon estimates which have been made at the telescope by astronomers while in the process of determining their positions, and are for the most part quite erroneous. They are also lacking quite a number of the brighter stars while many of the fainter are included."

Prager's Katalog und Ephemeriden veränderlicher Sterne für 1932 gives Max. J.D. 2414827.15 G.M.T.; Period $7^d.176678$; Max. $3^M.69$, Min. $4^M.40$. C. C. Wylie (*Astrophysical Journal*, November, 1922) finds that the range in magnitude as determined by the photo-electric cell is 1.12 magnitudes. He gives maximum J.D. 2422606.652; Period $7^d.176382$. Neither of these periods apparently fits the observations.

This is on the assumption that all these observations refer to Eta Aquilae. There is no definite statement that any of these refer to that variable. I am presenting the notes as they appear in the hopes that someone having access to old series of observations may find these of value.

These observations were made at Dr. Rittenhouse's Observatory at Seventh and Arch Streets, Philadelphia.

SPROUL OBSERVATORY, SWARTHMORE COLLEGE, SWARTHMORE, PENNSYLVANIA.

Temperature Observations at Fryeburg, Maine, during the Total Solar Eclipse of August 31, 1932

By WILLIS I. MILHAM

These temperature observations were made at Fryeburg, Maine, on the campus of the Academy, near the center of the town, where several eclipse expeditions were located. They were taken in the open, over grass, near the middle of the campus so that there was a fairly level

area extending several hundred feet in all directions without trees or buildings. The temperature was determined every ten minutes from approximately 1:30 P.M. to 5:30 P.M. by means of an accurate Assmann ventilated thermometer. A thermometer of this kind gives the *real air temperature* free from appreciable lag or any error due to the absorption or emission of radiation. As is well known, the *real air temperature* cannot be determined by a thermometer in the open or even in a thermometer shelter, particularly in eclipse work. The nearest approximation to it is a thermometer whirled in a thermometer shelter or a sling thermometer operated in the open behind a screen shutting off the sun's rays or a thermometer behind a screen with a current of air blown against it by a small electric fan.

The observations were taken at a height of four feet above the grass. The general procedure was as follows. The instrument was held with the bulbs of the two thermometers away from the observer four feet above the grass and about a foot and a half from the observer. The observer then turned in one minute through 360°, observing the thermometers all the while. The average of their indications during the minute was considered the temperature at that time. Ordinarily there would not be a difference of as much as 0°.2 Centigrade, during the minute in all positions.

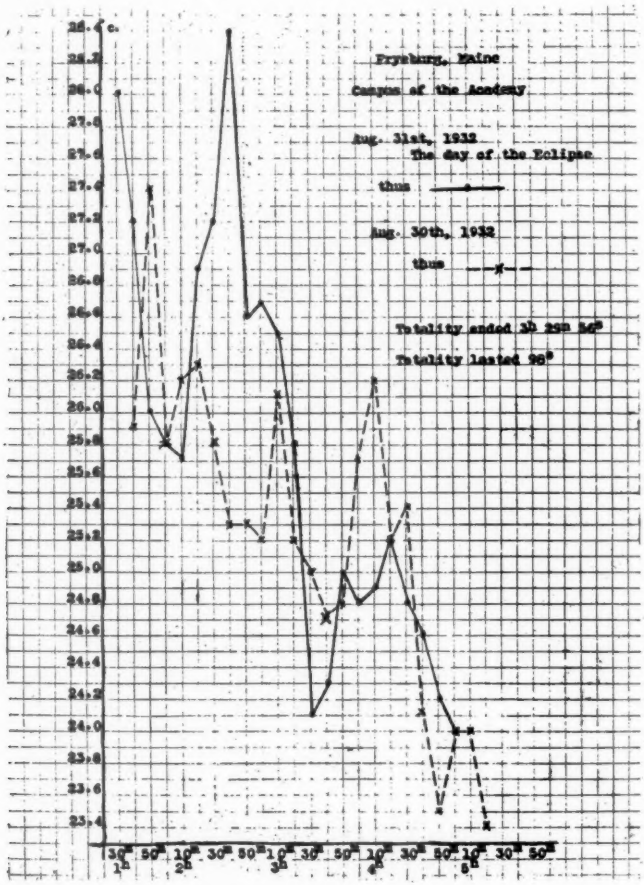
The temperature observations were taken not only during the afternoon of August 31, 1932, the day of the eclipse, but during the afternoon of the day before as well. Fortunately these two days were very similar. The wind was light and variable in direction in both cases and the amount of cloudiness and the drop in temperature during the afternoon were approximately the same. These observations are given in full in the accompanying table and are shown graphically in the figure.

These temperatures show at a glance that the popular idea that the temperature drops quite a few degrees during totality and then returns at once to its previous value is entirely erroneous. The eclipse effect is simply to distort slightly the normal afternoon drop in temperature. The minimum came at the end of totality. This was followed by a slight recovery lasting nearly an hour, which in turn was followed by the regular afternoon drop in temperature.

Three conclusions need to be particularly emphasized: *First:* The eclipse effect is of the order of one to two degrees centigrade only. This is what would be theoretically expected. Around the first of September in any New England village the minimum temperature occurs normally about 6:00 A.M. and the maximum about 2:00 P.M., and the normal rise is of the order of 10° C to 15° C. This means a rise due to the sun's radiation of from one to two degrees centigrade an hour. The eclipse lasted from 2:19 P.M. to 4:33 P.M. During this time the sun's radiation was cut from the full amount to nothing and came back again to full amount. It would be equivalent to withdrawing the sun's radiation for a little over an hour. Thus a temperature effect of from one to two

degrees centigrade would be expected and that is exactly what is observed.

Secondly: The minimum comes at the end of totality or a little later and is followed by a slight slow recovery lasting perhaps an hour.



Thirdly: The eclipse effect on temperature is of the same order of magnitude as the irregular changes in temperature which occur any afternoon during a few minutes due to changes in cloudiness or slight changes in wind velocity or direction and the like.

Similar temperature observations were made by the author at Middletown, Connecticut, during the total solar eclipse of January 24, 1925. These were published in POPULAR ASTRONOMY, Vol. XXXIII, No. 6,

page 356, and show exactly the same results.

FRYEBURG, MAINE — CAMPUS OF THE ACADEMY.

August 30, 1932
Wind: light and variable in direction.
Clouds: lower part of sky about 0.5 covered, upper part 0.2, fracto-cumulus with a little cirrus at times.

August 31, 1932
Wind: light and variable in direction.
Clouds: fracto-cumulus from the S.E. before totality; strato-cumulus and higher after totality; sky totally cloudy after 4:00 P.M.
Totality ended $3^h\ 29^m\ 56^s$; length of totality 98^s.

Time P.M.	Temp. C	Sky Near Sun	Temp. C	Sky Near Sun
	——(Aug. 30, 1932)——		——(Aug. 31, 1932)——	
1:30	....	.....	28°0	clear
1:40	25°9	clear	27.2	clear
1:50	27.4	clear	26.0	cloudy
2:00	25.8	cloudy	25.8	cloudy
2:10	26.2	cloudy	25.7	clear
2:20	26.3	clear	26.9	cloudy
2:30	25.8	cloudy	27.2	clear
2:40	25.3	cloudy	28.4	clear
2:50	25.3	cloudy	26.6	cloudy
3:00	25.2	clear	26.7	cloudy
3:10	26.1	clear	26.5	clear
3:20	25.2	thin cirrus	25.8	clear
3:30	25.0	thin cirrus	24.1	very thin clouds
3:40	24.7	thin cirrus	24.3	thin clouds
3:50	24.8	thin cirrus	25.0	cloudy
4:00	25.7	clear	24.8	cloudy
4:10	26.2	clear	24.9	cloudy
4:20	25.2	cloudy	25.2	cloudy
4:30	25.4	clear	24.8	cloudy
4:40	24.1	thin cirrus	24.6	cloudy
4:50	23.5	clear	24.2	cloudy
5:00	24.0	thin cirrus	24.0	cloudy
5:10	24.0	cloudy		
5:20	23.4	cloudy		

Observations taken with an Assmann ventilated thermometer 4 ft. above grass.

Planet Notes for March, 1933

By CLIFFORD E. SMITH

The *Sun* will be moving in a northeasterly direction from the central part of Aquarius to the central part of Pisces. On March 20, at $7^h\ 43^m$ P.M., C.S.T., the sun will cross the celestial equator from south to north which event, officially, marks the beginning of spring. The distance from the earth to the sun at the beginning of the month will be about 92.0 million miles, and this distance will increase about 0.76 million miles during the month. The position of the sun on the first and last days of the month will be, respectively: R.A. $22^h\ 46^m$, Decl. $-7°\ 50'$; R.A. $0^h\ 36^m$, Decl. $+3°\ 54'$.

The phenomena of the *Moon* will occur as follows:

First Quarter	March	4 at	4 A.M.	C.S.T.
Full Moon		11 "	9 P. M.	"
Last Quarter		18 "	3 P. M.	"
New Moon		25 "	9 P. M.	"
Apogee		3 "	12 M.	"
Apogee		31 "	7 A.M.	"
Perigee		15 "	11 A.M.	"

Mercury will be in western Pisces, and its apparent motion will be easterly until March 13. During the first part of the month it will be an evening star setting about an hour and a quarter after the sun. Greatest elongation east will occur on March 6 (18° 14'). Inferior conjunction will occur on March 23, and after that date Mercury will be a morning star. The distance from the earth to Mercury will be about 100 million miles at the beginning, and at the end of the month this distance will be about 57 million miles. The corresponding apparent diameters will be 6 and 11 seconds of arc.

Venus will be near the sun in apparent position during this period since superior conjunction will occur in April. At the beginning of the month it will rise about a half hour before the sun, and its distance from the earth will be about 155 million miles. Venus will pass through its aphelion point on March 2.

Mars will be above the horizon in eastern Leo most of the evening hours during this period since opposition will occur on March 1. During the first few days of the month Mars will be nearest the earth for this apparition, and its distance will be about 63 million miles. The distance will have increased to about 70 million miles by the end of the month. Conjunction with the moon will occur on March 11, and on that date Mars will be in conjunction with Neptune also.

Jupiter, like Mars, will be above the horizon most of the evening hours in eastern Leo. Opposition will occur on March 9. Jupiter, also, will be in conjunction with the moon on March 11. Its distance from the earth will be about 410 million miles, and its apparent diameter will be about 40 seconds of arc.

Saturn will be a morning object in central Capricornus. During the middle of the month it will be on the meridian about $9^h\ 30^m$ A.M., Standard Time, and, at that time, its distance from the earth will be about 990 million miles and its apparent diameter will be about 14 seconds of arc. Conjunction with the moon will occur on March 22.

Uranus will be too near the sun in apparent position to be of interest since conjunction with the sun will occur in April.

Neptune, too, will be in Leo, and, since opposition occurred late in February, it will be above the horizon most of the night hours. On March 11 it will be in conjunction with Mars and with the moon. During the middle of the month its distance from the earth will be about 2700 million miles, and its apparent diameter will be about $2\frac{1}{2}$ seconds of arc.

Summary of Sun-Spot Observations at Mount Holyoke College, 1932

Month	No. of Obs.	North of Equator No. of Groups	North of Equator Av. Lat.	South of Equator No. of Groups	South of Equator Av. Lat.	Av. No. at one Obs.	New Groups
January	9	2	+11°0	4	— 8°6	1.22	6
February	14	3	12.2	2	11.5	0.50	3
March	15	4	7.7	2	3.5	0.87	5
April	18	2	5.5	1	7.6	0.72	2
May	19	5	8.9	4	6.8	1.84	9
June	16	8	6.1	1	5.3	1.81	8
September	9	1	10.5	2	4.2	0.67	3
October	17	4	9.8	3	6.0	0.76	7
November	19	3	7.1	1	— 4.5	0.53	3
December	19	2	+ 8.0	0		0.63	1
Totals	155	34		20			47

Average number at one observation 0.96
Average latitude of spots north of equator +8°7
Average latitude of spots south of equator —6°3
No spots were seen on 56 days of observation.
No record was kept from June 24 to September 21.
Most of the observations were made by Miss Helen Porter.

ANNE S. YOUNG.

John Payson Williston Observatory.

Variable Stars

Monthly Report of the American Association of Variable Star Observers for December, 1932

The Galileo High School, San Francisco, California, is here represented for the first time with the observations of Henry Raphael; observations made with binoculars to be sure but evidence of real interest on the part of the student.

We regret to report the passing of Mr. Kaname Nakamura of Kobe, Japan, at one time an active observer in our ranks. In more recent years he had become interested in telescope making, and was without doubt the leading amateur telescope maker of Japan.

Observations just received indicate a broad maximum of U Geminorum on January 2. It was caught on the rise, magnitude 12.5, by Mr. Bouton on December 28. The last observed maximum occurred on March, 1932, and was also of the broad type. SS Aurigae was at maximum on November 15 and again about December 18. SS Cygni was observed near maximum on December 12.

In order not to impose unduly on the Editors of POPULAR ASTRONOMY by filling up their columns with too many observations of doubtful variables and those with rather small range, henceforth only those observations made on the regular long period variables and the irregular variables of large range will be tabulated here. Those observations not printed will be duly plotted, ledgered, and filed with the A.A.V.S.O. records for future use by anyone so desiring.

Of interest to the members is the announcement that the twenty-second annual Spring Meeting of the Association will be held at the Connecticut College for Womn at New London, Connecticut, on Saturday, May 20, 1933.

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1932.

Oct. 0 = J.D. 2426981; Nov. 0 = J.D. 2427012; Dec. 0 = J.D. 2427042.

V SCL *000339*

J.D.Est.	Obs.
986	11.0 Bl
003	10.5 Bl
009	10.0 Bl

S SCL *001032*

J.D.Est.	Obs.
986	6.5 Bl
999	6.3 En
999	6.7 Ht
003	6.3 Bl
006	6.7 En
006	6.6 Ht
009	6.3 Bl
011	6.6 Ht
034	7.1 Me
037	7.0 Pt

X AND 001046

J.D.Est.	Obs.
010[	13.4 Ch
040[	13.8 Bw

T CET *001620*

J.D.Est.	Obs.
034	6.5 L

T AND 001726

J.D.Est.	Obs.
973	9.0 Ch
000	10.3 Ch
016	12.2 Jo
032	12.7 Co
032	12.7 Eb
033	12.3 El
034	12.3 Wr
037	12.8 Pt
039	12.8 El
040	12.6 Me

T CAS 001755

J.D.Est.	Obs.
000	12.1 Ch
015	12.0 L
016	12.4 Jo
029	12.3 Jo
034	12.4 Jo
034	11.9 Wr
036	12.0 L
037	11.9 Pt
040	11.6 Me
040	12.5 Jo

R AND 001838

J.D.Est.	Obs.
018	11.8 An
032	13.8 Ie
033	13.4 El
034	11.8 Wd
037	12.3 Pt
039	13.2 El
040	12.3 Me

S TUC *001862*

J.D.Est.	Obs.
986	10.0 Bl
999	9.8 En
999	9.9 Ht
003	10.0 Bl
006	9.8 En
009	10.2 Bl
011	10.4 Ht

S CET *001909*

J.D.Est.	Obs.
973	8.6 Ch
001	9.6 Ch
014	10.2 Jo
018	10.3 An
018	10.6 L
029	11.4 Ko
030	11.4 Jo
034	11.7 Jo
035	11.7 El
037	11.6 Jo
037	12.0 Pt
037	11.8 L
039	11.9 Ko
039	11.9 El
040	12.0 Jo
040	12.0 Me

T SCL *002438a*

J.D.Est.	Obs.
006	9.5 En

T PHE *002546*

J.D.Est.	Obs.
986	9.7 Bl
999	9.7 En
999	9.5 Ht
003	9.7 Bl
006	10.0 En
006	10.1 Ht
009	10.3 Bl
011	10.0 Ht

Y CEP 003179

J.D.Est.	Obs.
000[	11.8 Ch

U CAS 004047a

J.D.Est.	Obs.
997	12.0 Ch
014	12.5 Jo
015	12.8 L
032	13.9 Bw
038	13.9 L

RW AND 004132

J.D.Est.	Obs.
000	13.2 Ch
037[	13.5 Pt
042[	13.2 Wr

V AND 004435

J.D.Est.	Obs.
000	10.2 Ch
014	9.6 L
016	9.5 Jo
023	9.5 B
029	9.2 Jo
032	9.4 Co
032	9.5 Eb
032	9.0 Jo
037	9.5 L
043	9.7 Me

X SCL *004435*

J.D.Est.	Obs.
003	11.4 Bl
009	11.2 Bl

RR AND 004533

J.D.Est.	Obs.
000	9.4 Ch
016	8.8 Jo
023	8.6 B
029	9.0 Jo
032	8.9 Jo
033	9.2 El
039	9.7 El
040	8.7 Jo
043	9.5 Me

RV CAS 004746a

J.D.Est.	Obs.
997[	11.5 Ch
037	9.0 Pt

— CAS 004746b

J.D.Est.	Obs.
037	10.8 Pt

W CAS 004958

J.D.Est.	Obs.
000	12.0 Ch
016	11.4 Jo
029	11.5 Jo
032	11.4 Ko
033	11.1 El
034	11.3 Jo
034	11.2 Me
037	11.2 Pt
039	11.1 El
040	11.0 Jo
042	11.0 BL
043	11.1 BL
050	11.0 BL

U TUC *005475*

J.D.Est.	Obs.
986	9.4 Bl
999	10.0 En
999	10.5 Ht
001	10.2 Sl
003	10.5 Bl
006	10.5 En
009	11.0 Bl
011	11.1 Ht

Z CET *010102*

J.D.Est.	Obs.
010	11.7 Ch
028	10.0 L
029	9.9 Ko
033	10.0 Sl
035	9.6 El
037	9.7 Pt
037	9.8 L
039	9.1 Ko
039	9.2 El
042	9.0 B

U SCL *010630*

J.D.Est.	Obs.
003[	13.2 Bl

U AND 010940

J.D.Est.	Obs.
014	11.9 L
032	10.8 Jo
035	10.6 El
036	10.3 L
039	10.5 El
041	10.5 Gy

UZ AND 011041

J.D.Est.	Obs.
000	11.6 Ch
015	12.5 L
023	12.1 B
032	13.1 Bw
035	13.0 El
036	13.2 L
039	13.0 El
040	13.3 Bw

S PSC 011208

J.D.Est.	Obs.
018	10.3 L
030	11.7 Jo
035	11.4 El
037	11.3 L
039	11.5 El
040	12.0 Me

S CAS 011272

J.D.Est.	Obs.
006[	11.9 Ch
037[	13.2 Pt
042[	13.2 Wr

U PSC 011712

J.D.Est.	Obs.
010[	13.7 Ch
035[	13.5 El
037	14.4 L
041[	12.6 Gy

RZ PER 012350

J.D.Est.	Obs.
010	10.2 Ch
015	11.0 Jo
015	10.2 L
032	8.9 Jo
034	9.4 Me
035	9.2 El
036	9.5 L
039	9.3 El

R PSC 012502

J.D.Est.	Obs.
006	9.1 Ch
017	9.0 We
032	10.3 Jo
034	10.7 Me
037	11.0 Pt
041	11.0 Gy

RU AND 013238

J.D.Est.	Obs.
000	11.5 Ch
015	11.5 Jo
015	11.1 L
023	10.8 B
030	11.7 Jo
036	10.6 L
037	11.3 Pt
040	10.8 Me
041	10.9 Gy

Y AND 013338

J.D.Est.	Obs.
000	10.0 Ch
015	10.7 Jo
015	11.7 L
023	11.5 B
037	12.6 Pt
037	12.2 L
040	12.8 Me

X CAS 014958

J.D.Est.	Obs.
016	10.4 Jo
019	10.7 Bn
029	9.8 Jo
033	10.6 Bn
037	9.5 Jo
037	9.7 Pt
040	9.4 Jo
040	10.6 Bn
045	10.6 Me

RR ARI 015023

J.D.Est.	Obs.
030	6.0 Mc
032	5.8 Mc
035	5.6 Mc

U PER 015254

J.D.Est.	Obs.
010	8.1 Ch
014	7.8 Jo
018	8.5 Ry
029	8.0 Jo
030	8.3 Ah
032	8.6 Mc
034	8.3 Jo
035	8.6 El

U PER 015254

J.D.Est.	Obs.
035	8.8 We
035	8.7 Mc
035	8.4 Me
037	9.0 Pt
037	8.4 Jo
038	8.6 My
039	8.6 El
040	8.2 Jo
040	9.1 Ry
042	8.9 BL
043	9.0 BL
045	8.9 My
047	9.5 B
050	9.4 BL

XX PER 015654

J.D.Est.	Obs.
010	7.8 Ch

S ARI 015912

J.D.Est.	Obs.
015	13.2 L
037	10.8 L

R ARI 021024

J.D.Est.	Obs.
986	12.3 Ch
018	12.9 L
034	12.3 L
037	12.4 Pt
043	10.8 Me
043	11.6 B

W AND 021143a

J.D.Est.	Obs.
997	9.8 Ch
014	10.9 Ko
015	11.0 Jo
029	11.6 Jo
030	11.9 Jo
032	11.5 Eb
032	11.7 Co
032	11.5 Ko
037	11.8 Pt
040	12.4 Jo
041	11.9 Gy
045	11.7 Me

T PER 021258

J.D.Est.	Obs.
014	8.5 Jo
029	8.6 Jo
030	8.7 Ah
031	8.8 Me
034	8.6 Jo
035	9.8 We
035	8.6 El
037	8.6 Pt
037	8.5 Jo
038	8.9 My
039	8.6 El
040	8.5 Jo

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1932.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T PER	**S PER**	**R TRI**	**W PER**	**Y PER**	**X PER**
021258	021558	023133	024356	032043	034930
042 9.0 BL	041 9.3 B	011 8.3 Ch	043 10.5 Cy	011 8.9 Ch	032 6.4 Mc
043 8.8 BL	042 9.6 BL	014 8.1 Jo	044 9.8 Me	014 8.6 Jo	035 6.1 Mc
045 8.7 My	043 9.6 BL	016 7.9 Jo	045 9.4 My	022 8.6 Ko	**T ERI**
050 8.7 BL	045 9.4 My	020 7.9 Ah	047 9.2 B	029 8.3 Jo	*035124*
Z CEP	050 9.4 BL	026 7.3 Sh	**R HOR**	030 9.1 Ah	006 10.8 En
021281	**R CET**	029 7.2 Sh	*025050*	032 8.9 Mc	032 11.8 Me
009[11.5 Ch	*022000*	029 7.6 Jo	982 8.8 Sl	032 8.8 Sq	**R TAU**
037[12.5 Pt	986 8.5 Ch	030 7.3 Ah	986 10.0 Bl	034 8.2 Jo	042209
041[11.0 Gy	010 7.5 Ch	031 7.4 Me	999 10.6 En	035 8.9 El	010[13.0 Ch
o CET	015 7.6 Jo	034 7.2 Sh	999 10.4 Ht	035 9.5 We	043 13.8 B
021403	018 7.9 L	034 7.3 Jo	001 9.4 Sl	035 8.8 Mc	**W TAU**
006 9.2 En	028 8.2 L	035 6.6 Wd	003 10.4 Bl	035 8.7 My	042215
010 9.2 Ch	029 8.4 Jo	035 6.2 Hf	006 10.9 En	035 9.1 Me	010 10.6 Ch
015 9.4 Cy	034 9.0 Jo	036 7.0 Sf	009 10.3 Bl	035 8.4 Ko	015 10.8 Jo
015 8.6 Jo	035 8.8 Me	037 7.0 Pt	011 10.6 Ht	037 8.3 Pt	015 10.9 L
018 9.1 L	037 8.9 L	037 6.9 Jo	**T HOR**	037 8.4 Jo	016 10.6 Cy
022 9.0 Cy	037 9.6 Jo	038 6.8 Oy	*025751*	039 8.2 Sq	029 11.0 Jo
026 9.4 Cy	040 9.9 Jo	039 7.7 Je	982 7.8 Sl	039 8.8 El	032 11.4 Me
029 9.1 Jo	040 9.2 Lg	040 6.5 Jo	986 8.5 Bl	040 8.0 Jo	034 10.6 Jo
030 9.3 Ah	040 9.0 Sf	041 6.6 Oy	999 8.0 En	040 8.0 Lg	034 11.2 Bw
032 9.0 Wd	042 9.2 Hf	041 7.3 Ah	999 9.2 Ht	042 9.2 BL	036 11.2 L
034 9.1 Wd	**RR PER**	041 6.6 Gy	001 8.2 Sl	043 8.6 BL	037 10.5 Pt
034 8.8 Jo	022150	043 6.4 Hf	003 9.4 Bl	047 8.6 B	037 11.0 My
035 9.2 We	011 8.2 Ch	043 6.7 Sf	006 9.0 En	050 8.4 BL	040 11.0 Jo
035 9.1 Wd	015 7.9 L	**T ARI**	009 9.7 Bl	**R PER**	042 11.1 Lg
035 9.0 Me	032 8.4 Jo	024217	011 9.6 Ht	032335	042 10.6 Bw
035 9.0 Hf	034 8.3 Jo	014 10.4 Jo	**U ARI**	010 9.8 Ch	042 11.3 Cy
035 9.0 GD	035 8.1 El	029 10.2 Jo	030514	014 9.9 Jo	043 11.0 B
036 9.3 Je	035 8.8 We	029 11.2 Ko	011 12.6 Ch	018 9.5 L	045 11.1 My
037 9.1 Jo	035 8.3 Me	030 10.9 Me	015 12.9 L	029 9.5 Jo	**S TAU**
037 9.6 Oy	036 8.4 L	037 10.0 Jo	035 13.4 El	029 8.9 Lg	042309
037 9.0 Pt	037 8.7 Pt	039 11.0 Ko	037 13.5 El	034 9.0 Jo	010 11.8 Ch
037 9.1 L	037 8.3 Jo	040 10.2 Jo	037 13.6 L	034 9.2 Lg	037 13.2 Pt
039 9.2 Je	039 8.3 El	046 10.5 Me	042 13.8 El	035 8.9 El	**T CAM**
040 9.2 Jo	040 8.1 Jo	**W PER**	043 13.7 B	036 9.0 L	043065
041 9.4 Oy	044 8.8 B	024356	**X CET**	037 9.3 Pt	009 7.9 Ch
042 8.9 Lg	**R FOR**	973 9.8 Ch	*031401*	037 9.1 Jo	014 7.7 Jo
042 9.2 BL	*022426*	011 9.3 Ch	006 9.4 Ch	038 8.9 My	018 8.0 L
043 9.1 BL	986 11.2 Bl	014 9.1 Jo	015 8.8 Jo	039 8.7 El	026 7.9 Ko
047 9.2 Me	003 11.0 Bl	016 9.8 Cy	018 9.3 L	040 8.7 Jo	029 8.3 Jo
050 9.3 Wd	009 10.6 Bl	018 9.3 Ry	028 9.0 L	043 8.6 Co	034 8.2 Jo
050 9.4 Hf	035 11.2 Me	022 9.1 Ko	029 9.0 Jo	043 8.7 Eb	034 8.4 L
050 9.1 BL	**U CET**	026 9.8 Cy	029 8.8 Lg	045 8.9 My	034 8.3 Lg
S PER	*022813*	029 9.4 Jo	033 9.0 Me	045 8.8 Me	035 8.8 Wd
021558	011 11.7 Ch	030 10.0 Mc	034 9.1 Jo	047 8.9 B	035 8.5 My
014 9.3 Jo	018 11.9 L	030 9.5 Me	035 8.7 El	**NOV PER**	035 8.3 El
029 9.2 Jo	032 12.5 Jo	032 10.0 Mc	037 8.7 El	032443	035 8.8 Hf
030 9.4 Ah	035 12.9 Me	034 9.2 Jo	037 9.4 Jo	035 13.3 Me	036 8.2 Ko
031 9.9 Me	037 13.1 Pt	035 9.5 El	037 8.8 My	037 13.3 Pt	037 8.5 Pt
032 9.3 Sz	037 12.9 L	035 9.4 We	037 9.0 Pt	**T FOR**	039 8.5 El
034 9.1 Jo	042 12.7 Wr	035 10.1 Mc	037 9.1 L	*032528*	039 9.1 Hf
035 9.4 El	042 12.2 BL	036 9.4 Ko	040 9.1 Sf	034 8.6 L	039 8.2 Jo
035 9.6 We	**RR CEP**	037 9.8 Pt	041 8.9 Gy	**U ERI**	040 9.0 Me
037 9.2 Jo	022980	037 9.3 My	043 8.8 Lg	*034625*	042 8.9 BL
037 9.3 Pt	009[11.6 Ch	037 9.3 Jo	045 9.3 My	006 11.5 En	042 8.8 Hf
038 10.0 My	037[12.9 Pt	039 9.7 El	050 9.1 Lg	**X PER**	043 9.0 BL
039 9.2 El	041[11.0 Gy	040 9.0 Jo		034930	045 9.1 My
040 9.1 Jo		040 9.6 Ry		030 6.7 Mc	050 9.1 BL

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1932.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

RX TAU
043208
010 13.0 Ch
018 13.0 L
034 13.8 Bw
035 13.7 El
037 13.8 El
037 13.7 L
040 13.9 Bw
043 14.1 Co
043 13.8 B

R RET
043263
983 9.3 Sl
986 10.0 Bl
999 10.4 Ht
001 10.5 Sl
003 10.3 Bl
006 11.4 En
009 11.2 Bl

X CAM
043274
009 8.6 Ch
015 8.7 Jo
018 9.8 L
029 10.5 Jo
030 10.8 Me
034 11.1 Me
034 10.7 Jo
034 10.6 L
035 11.2 My
037 11.0 Pt
039 11.1 Jo
043 11.8 Me
043 11.5 B
043 9.7 Hf
045 11.6 My

R DOR
043562
983 4.9 Sl
986 5.4 Bl
999 5.5 Ht
001 5.1 Sl
003 5.5 Bl
006 5.3 En
009 5.6 Bl

R CAE
043738
986 9.0 Bl
003 7.4 Bl
009 7.7 Bl
011 7.7 Ht

R PIC
044349
986 7.2 Bl
003 7.1 Bl
009 7.2 Bl
011 7.3 Ht

V TAU
044617
006 10.5 Ch
015 12.5 Jo
035 13.7 El
037 14.1 El
037 13.2 Pt

R ORI
045307
015 9.7 L
036 9.7 L
036 9.0 Jo
040 9.6 Me

R LEP
045514
001 7.8 Sl
015 7.7 Jo
018 8.4 L
032 7.7 Jo
032 9.2 Me
034 7.6 Jo
036 8.6 Ko
037 8.0 L
037 7.8 Pt
038 8.7 Je
039 7.7 Jo
041 9.6 Gy
043 9.0 Hf

V ORI
050003
018 10.6 L
034 9.6 Jo
036 10.4 L
037 10.3 Pt
037 9.4 Jo
046 10.1 Me

T LEP
050022
986 11.3 Bl
003 11.0 Bl
009 10.6 Bl
015 10.3 Jo
032 9.6 Jo
032 10.6 Me
034 9.5 Jo
037 10.5 Pt
039 9.3 Jo
039 11.0 Ko

S PIC
050848
003[13.4 Bl
011[12.9 Ht

AE AUR
050934
032 5.5 Mc
035 5.9 Mc

R AUR
050953
015 11.4 Jo
015 10.0 Mn

R AUR
050953
018 9.7 Je
019 10.0 Mn
025 10.2 Wd
029 11.0 Jo
029 10.0 Mn
033 11.8 Pt
034 10.8 Wd
036 10.4 Jo
037 10.0 My
039 10.2 Jo
039 10.0 Je
040 9.5 Hf
042 9.9 Mn
046 11.0 Me
047 10.7 Wd
050 11.2 Co
050 10.9 Eb

T PIC
051247
986 10.9 Bl
003 9.3 Bl
009 8.8 Bl
011 8.7 Ht

T COL
051533
003 8.2 Bl
009 7.5 Bl
011 7.8 Ht

S AUR
052034
006 9.8 Ch
015 8.6 Jo
032 8.8 Jo
032 9.3 Mc
033 8.5 Pt
034 9.8 We
035 8.9 Ko
037 8.7 Jo
037 9.1 My
038 8.9 My
040 9.8 Me
041 9.3 Gy
042 9.4 BL
043 9.2 BL
043 8.6 B
043 9.9 Hf
045 9.0 My
050 9.3 BL

W AUR
052036
006 10.2 Ch
015 10.0 Jo
015 10.6 L
032 10.9 Jo
033 11.2 Pt
035 11.2 L
037 11.6 Jo
040 11.3 Me

W AUR
052036
044 11.6 B
050 12.2 Co
050 12.2 Eb

S ORI
052404
032 9.7 Jo
033 10.2 Pt
034 10.2 We
034 9.6 Jo
035 10.0 El
039 10.1 El
039 10.2 Jo
041 10.2 Gy
046 10.5 Me

T ORI
053005a
980 10.0 Ma
014 10.1 L
015 10.2 L
015 10.1 Jo
016 10.0 L
017 10.1 L
018 10.2 L
026 10.1 L
027 9.9 Me
029 10.4 Jo
030 9.7 My
032 10.6 Jo
032 9.7 Me
033 9.7 Me
033 9.6 Pt
034 10.4 Jo
034 9.9 Me
034 9.8 Ko
035 9.6 My
035 9.9 Me
035 9.9 Ko
035 10.2 L
036 10.2 L
036 10.5 Jo
036 9.6 My
036 10.3 Pt
037 9.6 My
037 10.2 Pt
037 10.0 L
038 10.2 L
038 9.7 My
038 10.0 Pt
039 10.1 Pt
039 10.5 Ko
039 10.5 Jo
039 10.1 Me
040 10.7 Jo
040 10.2 Me
041 10.1 Me
041 10.4 Pt
043 10.1 Me
045 9.9 Me

T ORI
053005a
046 10.1 Me
047 10.0 Me
048 10.0 Me

AN ORI
053005t
980 11.4 Ma
033 11.6 Me
043 11.6 Me

S CAM
053068
009 8.5 Ch
014 8.3 Jo
029 8.2 Jo
031 8.7 Me
033 8.9 Pt
034 8.3 Jo
035 8.6 My
039 8.4 Jo
045 8.6 My

RR TAU
053326
014 11.0 L
015 11.0 L
016 11.2 L
017 12.5 L
018 12.4 L
030 12.0 Me
031 11.9 Me
032 12.1 Me
033 12.2 Pt
033 12.1 Me
034 12.1 Me
034 11.7 L
034 12.0 Ko
035 12.2 L
035 12.1 Me
035 12.1 Ko
036 12.1 L
036 11.8 Pt
037 11.7 Pt
037 12.1 Me
037 11.8 L
038 11.0 L
038 11.7 Pt
039 11.7 Pt
039 11.7 Ko
039 11.5 Me
040 11.9 Me
041 11.7 Me
042 12.0 Gy
042 11.7 Pt
043 12.0 Me
044 11.8 Me
044 11.8 B
045 12.1 Me
046 12.0 Me
047 11.9 Me
048 12.1 Me

RU AUR
053337
036[13.9 Bw
039[13.9 El

U AUR
053531
018 13.9 L
033 13.2 Pt
037 13.9 L

SU TAU
054319
014 9.3 L
015 9.5 L
015 9.2 Cy
016 9.5 L
017 9.6 L
018 9.5 L
021 9.3 Cy
026 9.2 Cy
026 9.5 L
031 9.7 Me
032 9.7 Me
033 9.6 Me
033 9.7 Pt
034 9.2 Ko
034 9.5 L
034 9.7 Me
035 9.7 Me
035 9.6 El
035 9.5 L
036 9.5 L
036 9.6 Pt
037 9.6 Pt
037 9.6 L
037 9.5 Me
038 9.6 Pt
038 9.4 L
039 9.6 Pt
039 9.5 Ko
039 9.5 Me
039 9.6 El
040 9.6 Pt
040 9.6 Me
041 9.6 Me
041 9.6 Pt
041 9.4 Gy
042 9.6 Pt
043 9.5 Me
044 9.6 Me
045 9.6 Me
046 9.7 Me
047 9.6 Me
048 9.6 Me

S COL
054331
003 12.8 Bl
009 12.9 Bl

Z TAU
054615a
015 13.4 L

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
Z TAU	Z AUR	X GEM	R GEM	T CMI	U CNC
054615a	055353	064030	070122a	072811	083019
035 13.2 Me	034 10.4 Jo	033 13.4 Me	030 8.0 Jo	988[12.0 Ch	988[12.4 Ch
036 13.3 L	036 10.2 Pt	034 13.3 Bw	032 8.5 Jo	036[12.0 Pt	018 14.3 L
RU TAU	038 10.0 My	035 13.7 Bn	034 7.9 Wd	S VOL	037[14.7 L
054615c	039 10.3 Jo	040 13.7 Bn	034 7.9 Me	*073173*	039[14.1 El
015 12.8 L	041 10.2 Pt	041 12.9 Gy	035 8.0 Wd	003 11.8 Bl	X UMA
035 13.3 Me	045 9.8 My	042 13.7 Bw	035 8.0 Hf	009 12.5 Bl	083350
036 12.6 L	047 10.3 Me	Y MON	036 7.2 Pt	U CMI	015 10.0 Jo
R COL	R OCT	065111	037 7.7 Jo	073508	032 10.8 Jo
054629	*055686*	988 11.5 Ch	038 8.2 Je	988 10.0 Ch	034 11.4 Jo
003 12.0 Bl	997 7.8 Ht	018 10.6 L	041 7.6 Ah	015 9.5 Jo	036 11.6 Pt
009 12.0 Bl	001 7.5 Sl	034 9.2 Jo	043 7.9 Hf	015 9.8 L	040 11.8 Jo
α ORI	003 7.6 Bl	035 9.5 L	047 7.3 Wd	026 10.2 L	S HYA
054907	009 7.9 Bl	036 9.6 Pt	047 7.6 Me	032 9.5 Jo	084803
032 1.1 Mc	011 8.5 Ht	047 8.9 Me	050 7.7 Hf	035 10.5 L	988 10.6 Ch
035 1.2 Mc	X AUR	050 8.7 Eb	Z GEM	036 10.7 Pt	035 7.7 El
043 0.7 Se	060450	050 9.0 Co	070122b	S GEM	036 7.7 Pt
U ORI	988 12.6 Ch	X MON	034 12.6 Wd	073723	039 7.9 El
054920a	010 10.4 Ch	*065208*	036 12.5 Pt	988 12.9 Ch	043 7.7 Me
006 9.6 Ch	015 9.5 Jo	018 7.3 L	TW GEM	036[13.5 Pt	T HYA
015 7.8 Jo	018 9.4 L	035 7.5 L	070122c	W PUP	*085008*
017 9.2 We	032 8.9 Jo	041 7.7 Gy	034 8.3 Me	*074241*	988 7.9 Ch
024 7.6 Oy	034 8.7 L	047 7.7 Me	036 8.2 Pt	003 8.3 Bl	026 9.9 L
025 7.7 Oy	036 9.0 Pt	R LYN	R CMI	009 8.0 Bl	036 10.5 L
025 7.8 Wd	037 8.5 Jo	065355	070310	T GEM	036 10.2 Pt
029 7.5 Jo	040 8.3 Jo	988 8.1 Ch	988 10.5 Ch	074323	T CNC
032 6.8 Jo	043 8.7 Sf	015 8.1 Mn	015 10.1 Jo	988 11.9 Ch	085120
032 7.7 Mc	044 9.0 Hf	019 8.2 Mn	018 10.8 L	036[13.1 Pt	991 9.5 Ch
033 7.0 Pt	050 8.8 Eb	026 7.8 L	035 10.7 L	039[14.0 El	015 8.2 Jo
033 7.6 Je	050 8.7 Co	029 8.6 Mn	036 10.8 Pt	U PUP	032 7.8 Jo
034 7.2 Wd	η GEM	030 8.9 Ah	036 9.8 Jo	*075612*	036 8.0 Jo
034 6.6 Jo	060822	032 8.5 Jo	040 9.6 Jo	988[13.2 Ch	036 8.0 Pt
035 7.6 Hf	042 3.5 Se	036 8.2 Pt	RR MON	R CNC	040 8.1 Jo
035 7.4 Wd	V AUR	037 8.6 L	071201	081112	V UMA
035 7.3 Mc	061647	039 8.6 Jo	988[13.4 Ch	988 9.9 Ch	090151
037 7.4 Oy	032 10.4 Jo	039 9.3 Je	037 14.7 L	036 10.8 Pt	032 9.7 Mc
038 7.4 Je	035 12.1 L	042 9.2 Mn	V GEM	043 10.9 Cy	035 10.7 L
039 7.6 Je	039 10.6 Jo	RS GEM	071713	V CNC	047 10.4 Me
039 7.4 Hf	V MON	065530	988 8.2 Ch	081617	W CNC
040 7.3 Hf	*061702*	032 10.0 Me	015 8.8 Jo	988 10.6 Ch	090425
040 6.9 Jo	036 13.2 Pt	036 9.8 Jo	018 9.1 L	018 11.7 L	018 10.3 L
040 7.1 Sh	AG AUR	036 10.1 Pt	035 9.9 El	035 12.4 L	036 10.8 L
041 7.2 Oy	062047	039 10.1 Me	035 9.8 L	036 12.6 Pt	036 10.8 Pt
041 7.0 Ah	026 9.5 L	046 10.1 Me	036 10.0 Pt	041 12.5 Gy	RW CAR
041 6.8 Gy	035 9.4 L	V CMI	036 10.9 Bw	RT HYA	*091868*
041 7.9 GD	UU AUR	070109	036 9.6 Jo	*082405*	003 13.0 Bl
044 7.0 Sh	062938	988 8.7 Ch	039 9.8 Jo	026 7.6 L	009 12.7 Bl
047 7.2 Wd	030 5.6 Mc	015 10.5 Jo	039 10.0 El	035 8.1 El	Y VEL
048 6.8 Sq	032 5.7 Mc	018 9.6 L	S CMI	036 7.6 Pt	*092551*
V CAM	035 5.6 Mc	035 10.1 L	072708	036 7.8 L	003[12.9 Bl
054974	R MON	036 10.2 Pt	988 9.4 Ch	039 8.0 El	R CAR
018 13.8 L	063308	036 10.5 Bw	015 10.2 Jo	043 8.2 Me	*092962*
036[12.8 Pt	988[12.2 Ch	040 9.8 Jo	032 10.9 Jo	R CHA	985 8.4 Bl
Z AUR	S LYN	041 10.1 Gy	036 10.7 Pt	*082476*	002 8.9 Bl
055353	063558	R GEM	036 10.6 Ko	983 8.1 Sl	009 9.0 Bl
014 10.2 Jo	035 13.8 El	070122a	039 10.9 Me	985 8.2 Bl	X HYA
029 10.4 Jo	036 13.2 Pt	015 9.0 Jo	040 11.8 Jo	001 8.4 Sl	*093014*
030 10.4 Me	039 13.6 El	025 8.4 Wd		003 9.0 Bl	036 10.6 Pt
033 10.2 Pt		029 8.7 Jo		009 9.3 Bl	041 11.1 Gy

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1932.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

Y DRA
093178
015 13.6 L
036 14.0 L
R LMI
093934
991 9.5 Ch
036 11.5 Pt
041 11.7 Gy
R LEO
094211
991 9.7 Ch
026 8.8 Me
030 8.2 Jo
036 8.0 Jo
036 8.2 Pt
039 8.6 Ma
040 7.8 Jo
Y HYA
094622
036 6.5 Pt
Z VEL
094953
003[12.8 Bl
V LEO
095421
036[12.8 Pt
RV CAR
120012
095563
003[13.1 Bl
S CAR
100661
985 5.5 Bl
002 5.5 Bl
009 5.7 Bl
U UMA
100860
015 6.5 Mn
019 6.4 Mn
029 6.4 Mn
Z CAR
101058a
003[12.6 Bl
W VEL
101153
003 11.7 Bl
009 11.6 Bl
R UMA
103769
016 12.2 Cy
039 12.6 El
041 12.6 Gy
041 12.5 Pt
042 12.5 Cy
V HYA
104620
027 6.9 L
036 7.0 Ko
036 7.0 L
041 6.8 Pt

W LEO
104814
018 11.0 L
035 11.5 L
041 11.6 Pt
S LEO
110506
018 12.4 L
035 12.0 L
041 11.4 Pt
RY CAR
111561
985 11.5 Bl
996 11.8 Bl
002 12.0 Bl
RS CEN
111661
985 8.9 Bl
996 8.9 Bl
002 8.5 Bl
008 8.1 Bl
W CEN
115058
996 12.5 Bl
002 11.6 Bl
008 11.4 Bl
SU VIR
120012
018 13.6 L
035 13.5 L
T VIR
120005
026 9.8 L
036 9.4 L
041 9.5 Pt
R CRV
121418
035 12.0 L
041[12.3 Pt
SS VIR
122001
026 7.7 L
036 7.9 L
036 7.5 Ko
T CVN
122532
021 9.9 Cy
041 9.6 Pt
Y VIR
122803
026 9.7 L
036 10.0 L
U CEN
122854
985 8.8 Bl
002 10.0 Bl
T UMA
123160
039 13.0 El
039 13.1 Ma

T UMA
123160
041 12.8 Pt
R VIR
123307
041 9.5 Pt
RS UMA
123459
023 12.0 Bn
034 12.2 Jo
034 11.5 Wd
037 11.7 Jo
039 11.0 El
039 11.4 Ma
040 11.0 Ry
040 11.0 Jo
040 11.2 Bn
041 10.7 Ah
S UMA
123961
973 8.2 Ch
014 7.6 Jo
014 7.9 Mn
019 8.0 Mn
020 7.8 Ah
025 8.0 Ah
029 7.1 Jo
029 8.0 Mn
030 8.1 Ah
030 8.5 Mc
032 8.1 Sz
034 8.4 Wd
034 7.9 Jo
035 8.6 Mc
038 8.2 Ma
039 8.1 El
039 7.8 Jo
041 8.7 Gy
041 8.3 Ah
041 8.6 Pt
042 8.2 Mn
RU VIR
124204
035 13.2 L
041 12.4 Pt
U VIR
124606
026 10.6 L
036 11.0 L
041 11.2 Pt
RV VIR
130212
035 11.9 L
U OCT
131283
985 9.7 Bl
996 9.3 Bl
997 9.1 Ht
002 9.2 Bl
008 8.5 Bl

U OCT
131283
011 8.5 Ht
V VIR
132202
035 10.5 L
038 10.3 Ma
R HYA
132422
035 8.9 L
041 8.6 Pt
S VIR
132706
041 9.7 Pt
RV CEN
133155
985 9.4 Bl
002 9.0 Bl
008 8.9 Bl
T UMI
133273
030 11.4 Jo
032 11.0 Jo
035 11.5 L
039 9.7 Jo
043 11.3 Cy
T CEN
133633
982 6.2 Sl
985 6.5 Bl
RT CEN
134236
985 9.0 Bl
R CVN
134440
041 8.4 Pt
RX CEN
134536
985 9.4 Bl
T APS
134677
985 9.4 Bl
996 9.5 Bl
997 9.1 Ht
002 9.5 Bl
008 9.6 Bl
Z BOO
140113
035 10.7 L
038 10.9 Ma
Z VIR
140512
035[12.7 L
RU HYA
140528
985 11.9 Bl
R CEN
140959
985 6.0 Bl
996 6.5 Bl

R CEN
140959
996 6.4 En
997 6.4 Ht
998 5.9 Sl
002 6.2 Bl
008 6.2 Bl
011 5.9 Ht
U UMI
141567
014 11.7 Jo
016 11.2 Cy
030 10.7 Me
032 10.6 Sz
034 10.5 Jo
039 10.2 Jo
041 10.1 Pt
041 11.9 Ah
043 9.6 Cy
S BOO
141954
014 11.0 Jo
026 9.9 L
029 9.6 Jo
035 9.9 L
039 9.5 Jo
041 9.0 Pt
041 10.0 Gy
RS VIR
142205
035 9.0 L
V BOO
142539a
973 8.8 Ch
015 8.3 Jo
015 7.7 Mn
019 7.8 Mn
021 7.8 Cy
029 7.6 Jo
030 7.9 Ah
041 7.8 Ah
041 7.8 Pt
043 7.4 Cy
R CAM
142584
986 9.6 Ch
009 8.8 Ch
015 8.0 Jo
016 8.4 Cy
026 8.5 Cy
037 8.3 Oy
041 9.1 Oy
046 8.9 Cy
R BOO
143227
041 9.2 Pt
U BOO
144918
046 12.0 Cy

Y LUP
145254
996[12.8 Bl
008[12.8 Bl
S APS
145971
986 11.5 Bl
996 11.5 Bl
996 11.9 En
997 12.0 Ht
998 11.2 Sl
000 11.5 En
001 11.0 En
002 11.0 Bl
006 11.9 Ht
008 11.1 Bl
011 11.8 Ht
S SER
151714
016 8.1 L
035 8.9 L
S CRB
151731
991 7.8 Ch
013 8.0 Ko
015 7.8 Mn
015 7.8 Jo
015 7.8 We
017 8.2 We
019 8.0 Mn
027 8.5 Ko
029 8.2 Mn
030 8.7 Ah
036 8.4 Ko
041 8.7 Pt
RS LIB
151822
985 11.5 Bl
R NOR
152840
986 11.2 Bl
996 11.5 Bl
997 11.7 Ht
002 11.6 Bl
008 11.6 Bl
X LIB
153020
985 12.3 Bl
S UMI
153378
014 11.5 Jo
014 12.0 Ko
029 11.3 Jo
030 12.5 Me
036 11.9 Ko
037 11.0 Jo
040 10.8 Jo
041 11.9 Pt
T NOR
153654
997 11.9 Ht

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J.D.Est.Obs.

R CrB
154428
973 5.8 Ch
991 6.2 Ch
008 6.1 Ch
008 6.0 Cy
009 6.0 Cy
010 6.0 Cy
013 5.9 Ko
013 6.0 Be
014 6.0 L
015 5.8 Jo
015 5.9 Mn
016 6.0 L
016 6.0 Cy
016 6.0 Be
019 5.8 Mn
021 6.0 Cy
022 5.9 Ko
024 6.0 Oy
025 5.9 Ko
026 6.1 Ah
026 6.0 Me
026 5.9 Pt
027 6.7 Se
028 6.0 Me
029 6.0 Me
029 6.0 Jo
029 5.9 Mn
029 5.9 Ko
030 6.1 Ah
030 6.0 Me
032 6.0 Me
032 6.0 Ko
033 6.0 Me
034 6.1 Jo
034 5.8 Pt
035 6.1 Me
035 6.0 L
036 6.0 L
036 6.0 Ko
037 6.0 L
037 6.2 Me
037 5.9 Pt
038 6.0 L
039 6.0 Me
040 5.9 Me
041 5.9 Pt
042 5.9 Pt
042 6.0 Cy
043 6.0 Cy
046 6.1 Me

X CrB
154536
016 10.2 L
017 10.0 We
036 9.8 L
041 9.7 Pt

R Ser
154615
041 6.6 Pt

V CrB
154639
015 7.5 Jo
026 7.7 Ah
029 7.7 Jo
030 7.5 Me
032 7.6 Jo
037 7.8 Jo
041 7.2 Pt

R Lup
154736
982 11.1 Sl
000 11.6 Sl

RZ Sco
155823
997 11.8 Ht

Z Sco
160021
997 10.7 Ht
002 10.5 Bl

R Her
160118
013 9.8 Ko
015 10.0 Jo
029 10.0 Jo

U Ser
160210
046 10.7 Cy

X Sco
160221a
002[12.5 Bl

SX Her
160325
013 8.4 Ko
014 8.3 L
015 8.1 Jo
018 8.2 An
026 7.8 Me
026 8.2 Pt
027 8.2 Ko
029 8.1 Ko
029 8.4 Jo
030 7.9 Me
032 8.0 Ko
034 7.8 L
034 8.2 Pt
037 8.2 Pt
041 8.2 Pt
042 8.2 Pt

W Sco
160519
002 11.8 Bl

RU Her
160625
009 10.6 Ch
013 10.7 Ko
014 10.2 L

RU Her
160625
015 9.8 Jo
026 10.7 Me
029 10.5 Jo
034 10.5 L

R Sco
161122a
997 10.4 Ht
002 10.6 Bl

S Sco
161122b
997[12.6 Ht
002 12.2 Bl

W CrB
161138
014 9.0 Jo
029 9.5 Jo
034 9.6 Pt

V Oph
162112
009 9.3 Ch

U Her
162119
991 12.0 Ch
015 12.3 Jo
029 12.0 Jo
034 10.9 Pt

SS Her
162807
016 10.7 L
018 10.6 An
036 9.5 L

W Her
163137
008 13.5 Ch
018 12.7 An
034 12.5 Pt
037 12.1 Bw

R UMi
173172
014 10.4 Jo
016 10.7 L
029 10.4 Jo
034 9.9 Jo
035 10.6 L
037 9.8 Jo
040 9.6 Jo
044 10.6 Me

R Dra
163266
973 11.9 Ch
014 9.1 Jo
014 9.6 Mn
019 9.0 Mn
029 7.8 Mn
029 8.0 Jo
029 8.1 Wd
030 7.9 Ah
031 7.9 Me

R Dra
163266
033 7.8 El
033 7.9 Hu
034 7.8 Jo
034 7.5 Pt
034 7.9 Wd
037 7.6 Jo
040 7.4 Jo
041 7.6 Ah
042 7.4 Mn
047 7.6 Wd
050 7.6 Wd
050 7.8 Hf

S Her
164715
008 11.6 Ch
029 10.9 Jo
034 10.6 Jo
034 10.3 Pt
036 10.3 Jo
040 10.0 Jo

RS Sco
164844
997 12.0 En
000 12.0 En
006 12.0 Ht
011 11.6 Ht
011 11.3 En

RR Sco
165030a
982 6.0 Sl
986 6.0 Bl
997 6.0 En
997 5.8 Ht
997 5.7 Sl
000 5.7 Sl
002 5.6 Bl
006 5.4 Ht
008 5.8 Bl
011 6.0 En
011 5.9 Ht

RV Her
165631
016 14.5 L
032 13.0 Bw
034 12.5 Pt
034 12.8 L
043 11.6 Bw

RT Sco
165636
002[14.0 Bl
011[12.1 En

R Oph
170215
988 7.8 Ch
018 7.5 L

RT Her
170627
983[12.4 Ch

RT Her
170627
034[12.4 Pt
045[12.9 Bw

RW Sco
170833
986 11.6 Bl
997 10.9 En
003 9.7 Bl
006 9.6 En
008 9.3 Bl
011 9.6 En

α Her
171114
027 3.1 Se

Z Oph
171401
014 8.6 Jo
016 8.8 Jo

RS Her
171723
014 12.0 Jo
034 12.6 Pt
036 12.7 Bw

S Oct
172486
986 8.4 Bl
997 8.4 Ht
003 8.3 Bl
008 8.2 Bl
011 8.3 Ht

RU Oph
172809
016 14.0 L
036 13.9 L

RU Sco
173543
986 8.5 Bl
997 8.8 En
003 8.5 Bl
006 8.9 En
008 8.5 Bl
011 9.1 En

SV Sco
174135
986 10.6 Bl
997 10.4 En
003 10.3 Bl
006 10.0 En
008 10.5 Bl
011 9.9 En

W Pav
174162
003[13.0 Bl
006[13.0 Ht
011[12.1 En

SU Her
174422
018 10.7 An

RS Oph
174406
034 11.1 Pt

U Ara
174551
997 8.7 Ht
000 9.0 En
006 8.6 En
011 9.5 En
011 8.7 Ht

RT Oph
175111
008[12.8 Ch
036 13.7 Bw

RY Her
175519
983 11.6 Ch
008 9.7 Ch
016 9.4 Jo
016 9.4 L
030 9.2 Jo
034 9.2 Pt
035 9.3 L
037 9.3 Jo
038 9.0 Bw

V Dra
175654
983[12.2 Ch
014 14.0 L
035 13.9 L

R Pav
180363
997 11.3 En
997 12.1 Ht
000 11.0 En
006 10.6 En
006 11.0 Ht
011 10.8 Ht
011 10.3 En

T Her
180531
008 7.8 Ch
014 7.9 Jo
016 7.9 L
017 8.3 An
017 8.3 Be
026 8.6 Ah
028 8.5 L
029 8.5 Jo
030 8.8 Ah
031 9.1 El
031 8.9 Me
033 9.0 El
033 9.1 Hu
034 9.7 Pt
037 9.2 Jo
037 9.6 L
040 9.3 Jo
041 9.6 Ah
044 9.9 Me

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1932.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

W DRA
180565
014 13.9 L
035 14.3 L

X DRA
180666
014[14.0 L
034[12.9 Pt

TV HER
181031
016 10.7 L
028 11.3 L
037 11.3 L

RY OPH
181103
016 9.0 Cy
026 10.2 Cy
034 10.7 Pt

W LYR
181136
014 9.7 Jo
015 10.5 We
016 10.5 L
017 10.0 An
017 10.1 Be
028 11.1 L
029 11.5 Jo
029 11.3 Wd
033 11.3 Pt
034 11.4 Wd
034 11.5 Jo
036 11.8 Jo
038 11.6 L
040 11.8 Jo
041 11.8 Me
047 11.8 B

RV SGR
182133
000 12.4 En
003 12.9 Bl
011 12.3 En

SV HER
182224
983 10.8 Ch
016 9.6 L
018 10.2 An
030 10.6 Jo
033 10.7 El
033 10.7 Pt
035 11.8 L
037 10.7 El
037 10.6 Jo
040 11.3 Jo
040 11.3 Bw

T SER
182306
983[12.2 Ch
033[12.2 Pt

SV DRA
183149
014 14.4 L
035 13.4 L

RZ HER
183225
014 13.5 L
035 11.9 L

X OPH
183308
983 8.5 Ch
014 8.4 Jo
014 8.7 Ko
014 8.6 L
015 8.5 Mn
016 9.0 Cy
019 8.5 Mn
024 8.4 Oy
026 8.9 Cy
026 8.4 Ko
029 8.5 Jo
029 8.4 Mn
033 8.4 Pt
035 8.4 L
036 8.2 Jo
036 8.2 Ko
040 8.3 Jo
041 8.1 Oy
041 8.5 Me
042 8.0 Mn
043 8.3 Cy

RS DRA
184047
986 11.0 Ch
009 10.4 Ch

RY LYR
184134
014 13.2 L
035 13.2 L

R SCT
184205
973 5.7 Ch
982 5.3 Sl
988 5.5 Ch
998 5.4 Sl
001 5.3 Sl
006 5.3 Sl
006 5.3 Cy
009 5.7 Ch
013 5.4 Be
013 5.4 Ko
014 5.5 Jo
015 5.5 We
015 5.7 Mn
016 5.3 Cy
016 5.6 L
018 5.5 Bc
019 5.8 Mn
022 5.8 Ko
024 6.0 Bc

R SCT
184205
024 5.6 Oy
025 5.3 Cy
025 5.7 Ko
026 5.9 Me
026 5.8 Pt
026 5.7 L
027 5.8 Ko
028 5.9 Bc
028 5.9 Ha
028 5.9 Me
029 6.0 Me
029 5.8 Ko
029 5.7 Jo
029 5.7 Wd
030 6.0 Me
031 6.0 Me
032 5.8 Ko
033 5.9 Bg
033 5.8 Hu
033 5.8 GD
033 6.0 Me
033 5.8 Pt
034 5.8 Pt
034 5.8 We
034 6.1 Me
034 5.9 Ko
035 6.1 Me
035 5.8 Mc
036 6.1 Bf
036 6.1 Bc
037 6.0 Jo
037 6.1 Mc
037 5.9 Pt
037 5.9 Ko
037 6.1 L
038 6.0 Se
040 6.2 Jo
040 6.3 Me
040 6.2 Pt
041 7.1 Oy
041 6.3 Me
042 6.4 Cy
042 6.8 Mn
042 6.4 Pt
043 6.4 Cy
044 6.4 Me
045 6.4 Me
049 6.7 Me
054 6.6 Pt

RW LYR
184243
041 13.8 B

NOV AQL
184300
975 10.7 Ch
029 11.0 Jo
033 11.5 Pt
034 11.2 Jo

NOV AQL
184300
040 10.9 Jo
040 11.4 Pt

RX LYR
185032
975 12.6 Ch
014 13.1 L
035 14.1 L

R LYR
185243
030 4.6 Mc
032 4.6 Mc
035 4.4 Mc

S CRA
185437a
982 12.2 Sl
998 12.1 Sl
999 11.4 Ht
000 12.0 En
001 12.1 Sl
003 11.5 Bl
006 12.0 En
006 12.0 Sl
011 11.7 Ht
011 12.0 En

ST SGR
185512a
005 8.5 Ch
014 8.0 L
038 8.0 L

R CRA
185537a
982 12.5 Sl
998 13.0 Sl
999 12.5 Ht
000 12.5 En
000 12.5 Sl
003 12.5 Bl
006 12.2 En
006 12.5 Sl
011 12.2 En
011 12.0 Ht

T CRA
185537b
982 12.8 Sl
998 12.7 Sl
999 12.5 Ht
001 12.5 Sl
003 13.0 Bl
006 12.8 Sl
011 12.5 Ht

Z LYR
185634
014 13.2 L
033 11.9 Pt
035 12.3 L
039 12.5 Bw
047 12.4 B

SU SGR
185722
999 8.7 Ht
011 8.5 Ht

RT LYR
185737
975 11.6 Ch
015 12.0 L
033 12.3 El
035 12.9 L
037 12.6 El
040 10.5 Jo

V AQL
185905
015 7.8 Mn
019 7.8 Mn
042 7.8 Mn

R AQL
190108
986 7.0 Ch
014 8.0 Jo
014 7.7 Ko
015 7.7 Mn
019 8.1 Mn
026 7.9 Ko
028 8.4 B
029 8.2 Mn
030 8.5 Ah
030 8.3 Jo
033 8.6 Pt
036 8.5 Ko
037 8.5 Jo
040 8.7 Jo
041 9.0 Me
042 9.7 Mn

V LYR
190529a
975 11.0 Ch
033[12.3 Pt

RX SGR
190818
974[12.7 Ch
000[12.4 En
011[12.7 Ht
033[12.4 Pt
036[12.7 L

RW SGR
190819a
974 10.2 Ch
999 10.0 Ht
000 9.6 En
011 9.7 En
011 10.1 Ht
015 9.7 L
033 9.3 Pt
036 9.6 L

TY AQL
190907
026 10.6 Me
030 10.3 Me

TY AQL
190907
031 10.4 Me
033 10.5 Pt
034 10.4 Me
035 10.6 Me
037 10.5 Me
040 10.7 Me
041 10.6 Me
044 10.5 Me
045 10.6 Me
049 10.5 Me

S LYR
190925
975[12.9 Ch
033[12.9 Pt
038[14.4 L
047 13.4 B

X LYR
190926
033 9.0 Pt

RS LYR
190933a
975 11.2 Ch
015 10.2 L
033 10.5 Pt
035 11.1 L
037 11.3 Jo
040 11.4 Jo
041 10.8 Gy

RU LYR
190941
975[13.3 Ch
033[12.3 Pt

U DRA
190967
983 12.2 Ch
015 13.1 L
033 13.4 Pt
035 13.5 L

W AQL
191007
015 12.3 L
036 12.9 L

T SGR
191017
007 12.3 Ch
033 11.4 Pt

R SGR
191019
974 7.4 Ch
999 8.0 Ht
000 8.0 En
005 8.1 Ch
011 8.2 En
011 8.6 Ht
017 8.7 L
022 9.1 Ko
026 9.4 Me
032 9.6 Ko

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1932.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

R SGR
191010
033 9.5 Pt
036 9.6 L
RY SCO
191033
986 7.1 Bl
996 7.3 En
998 6.9 Sl
999 7.1 Ht
000 7.5 En
001 6.9 Sl
003 7.2 Bl
005 6.8 Ch
006 6.7 En
008 7.0 Bl
011 6.7 En
011 6.5 Ht
014 6.9 L
015 7.0 L
016 7.0 L
018 6.8 L
026 6.8 L
026 6.6 Pt
026 6.5 Me
030 6.9 Me
031 6.8 Me
034 6.7 Me
035 6.7 Me
037 6.7 Me
044 6.7 Me
TY SGR
191124
003 11.6 Bl
008 10.7 Bl
S SGR
191319a
999[12.7 Ht
000[12.2 En
003[13.1 Bl
007[13.1 Ch
033[12.9 Pt
Z SGR
191321
000 11.9 En
011 12.2 En
015 10.9 L
038 9.0 L
SW SGR
191331
000 12.1 En
003 12.5 Bl
008 12.1 Bl
011 12.1 En
TZ CYG
191350
033 10.8 Pt
039 10.8 Jo
040 10.5 Jo

U LYR
191637
015 9.4 Jo
030 9.5 Jo
033 9.5 Pt
034 9.3 Jo
040 9.2 Jo
041 10.5 Me
AF CYG
192745
020 7.3 Ah
025 7.1 Ah
026 7.5 Ah
030 7.2 Ah
041 7.0 Ah
TY CYG
192928
017 13.3 L
036 13.0 L
RT AQL
193311
007 12.4 Ch
015 12.5 L
033 13.1 Pt
033 13.0 B
037 13.1 L
R CYG
193449
007 7.4 Ch
013 7.4 We
015 7.2 Jo
020 6.9 Ah
024 7.0 Oy
024 6.5 Ko
025 7.0 Ah
025 6.7 Je
026 6.9 Ah
026 6.5 Sh
026 6.5 Me
029 7.0 Jo
029 6.5 Sh
030 7.0 Ah
030 6.4 Mc
032 6.2 Mc
032 6.0 We
033 6.5 El
033 6.6 Je
033 6.7 Pt
034 6.8 Jo
034 7.5 Wd
034 6.5 Sh
035 6.7 Hf
035 6.8 Wd
035 6.4 Mc
036 6.5 Ko
037 6.6 El
037 7.1 Jo
037 6.3 Je
037 7.0 Oy
039 6.9 Hf

R CYG
193449
040 6.9 Hf
040 7.0 Jo
040 6.7 Sh
041 7.2 Ah
041 7.8 Gy
041 7.5 Oy
043 7.0 Hf
044 6.8 Sh
047 6.6 B
047 7.2 Wd
050 7.4 Wd
050 6.9 Sh
050 7.3 Hf
RV AQL
193509
016 13.6 L
037 12.5 L
T PAV
193972
986 8.8 Bl
997 8.7 Ht
003 9.1 Bl
008 9.0 Bl
011 9.1 Ht
RT CYG
194048
986 11.8 Ch
007 12.4 Ch
015 12.2 Jo
029 12.0 Jo
030 12.0 Jo
033 11.6 El
033 11.5 Pt
034 11.6 Wd
037 11.7 Jo
037 11.2 El
040 11.5 Jo
041 11.2 Ah
041 10.8 Me
041 10.2 B
047 10.6 Wd
050 9.9 Wd
050 9.9 Hf
TU CYG
194348
986 10.4 Ch
007 10.5 Ch
015 11.8 Jo
016 11.3 L
018 11.3 Ry
029 12.1 Jo
030 12.2 Jo
033 11.7 B
033 11.8 Pt
036 11.8 L
041 12.2 Me

X AQL
194604
007 11.1 Ch
014 12.0 Jo
016 11.3 L
023 11.7 B
033 12.5 Pt
036 12.5 L
χ CYG
194632
997 7.0 Ch
003 6.4 Je
006 6.0 Ch
009 5.4 Ch
014 5.2 Ko
015 5.0 Jo
018 5.1 Je
024 4.6 Oy
025 5.1 Je
026 5.1 Ah
026 5.2 Me
026 5.1 Ko
027 4.8 Se
028 4.9 Ra
028 5.0 Bg
029 4.5 Jo
029 5.3 Wd
029 4.9 Ra
030 5.0 Ah
030 4.9 Ra
031 5.0 Ra
032 5.0 Bc
032 5.6 Wd
033 5.3 El
033 5.0 Bg
033 5.3 Hu
033 5.1 Je
033 5.1 Ra
033 5.3 Pt
034 5.2 Jo
034 5.5 Wd
034 5.1 Ra
035 5.1 Bg
035 5.1 Ra
036 5.1 Bf
036 4.9 Bc
036 4.5 Jo
036 5.2 Ko
037 5.2 Bg
037 5.1 Je
037 5.3 Oy
038 5.3 Oy
038 5.4 Se
039 5.3 Bg
039 6.0 Hf
040 5.0 Jo
041 5.1 Ah
041 5.3 Bg
041 5.3 Gy
041 5.3 Oy

χ CYG
194632
041 5.3 Me
042 5.2 El
042 5.4 Bg
042 5.5 Se
043 5.5 Se
044 5.4 Bg
044 5.2 Ra
046 5.2 Ra
047 5.2 Ra
047 5.5 Se
047 5.8 Wd
049 5.2 Ra
050 5.5 Bg
050 5.8 Hf
050 5.7 Se
050 5.7 Wd
056 5.5 Bg
S PAV
194659
000 7.7 En
011 7.6 En
RR SGR
194929
003 12.6 Bl
009 12.2 Bl
RU SGR
195142
986 8.0 Bl
999 8.2 En
999 7.9 Ht
003 8.0 Bl
009 8.0 Bl
011 8.0 En
011 8.2 Ht
RR AQL
195202
017 13.5 L
033 13.4 B
RS AQL
195308
007 11.5 Ch
015 12.2 L
028 12.7 B
037 12.8 L
NOV CYG
195553
007[12.4 Ch
033[12.2 Pt
041[12.6 Me
RR TEL
195656
999[12.6 Ht
011 12.6 En
Z CYG
195849
016 13.1 L
033 12.6 Pt

Z CYG
195849
036 13.3 L
S TEL
195855
000 12.6 En
003 13.1 Bl
011 12.6 En
SY AQL
200212
007 9.8 Ch
016 9.6 L
032 9.7 Wa
033 10.2 Pt
035 10.0 Md
036 9.4 My
036 9.9 L
045 9.4 My
S CYG
200357
001 9.8 Ch
033 11.4 El
033 11.4 Wr
033 11.6 Pt
034 11.7 Wd
034 11.2 B
035 11.6 El
041 11.8 Gy
041 11.6 B
042 11.8 El
R CAP
200514
975 11.0 Ch
015 11.7 L
033 11.5 Pt
034 12.4 B
037 12.1 L
S AQL
200715a
007 9.4 Ch
015 9.4 Jo
026 9.4 Me
029 9.8 Jo
033 9.8 Pt
034 9.5 Jo
040 9.5 Jo
044 10.1 Me
RW AQL
200715b
015 9.6 Jo
029 9.5 Jo
033 9.1 Pt
034 9.6 Jo
040 9.2 Jo
R TEL
200747
986 8.7 Bl
000 9.6 En
003 9.0 Bl
009 9.5 Bl

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1932.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

R TEL
200747
011 9.6 En

RU AQL
200812
016 13.1 L
033 12.1 B
036 12.2 L

W CAP
200822
986 12.6 Bl
003 12.0 Bl
009 11.9 Bl
033 12.1 Pt

Z AQL
200906
008 11.1 Ch
018 10.3 An
033 10.0 Pt
034 9.2 Bw

R SGE
200916
015 9.2 Jo
026 9.2 Me
029 9.0 Jo
034 8.9 Jo
040 8.9 Jo
044 9.4 Me

RS CYG
200938
986 9.0 Ch
003 8.5 Je
005 9.0 Ch
009 8.9 Cy
015 7.8 Jo
016 8.9 Cy
017 8.1 L
018 8.2 Je
024 8.0 Ko
025 8.9 Cy
025 8.2 Je
028 8.0 L
029 8.7 Wd
029 8.0 Jo
031 8.7 Me
033 7.7 Pt
033 8.2 Je
033 8.5 GD
034 7.7 Jo
034 8.7 Wd
035 8.5 GD
035 8.7 Hf
036 7.9 Ko
036 8.0 Jo
037 8.0 L
037 8.5 GD
037 8.2 Je
039 8.6 Hf
040 8.6 Hf
040 7.7 Jo

RS CYG
200938
040 8.6 Sh
041 8.5 GD
042 8.7 Cy
044 8.6 Hf
047 8.7 Wd
050 8.6 Hf

R DEL
201008
014 11.9 Ko
016 11.6 Cy
018 11.5 An
018 11.8 L
026 12.0 Cy
033 12.2 El
033 12.6 Pt
034 9.7 Jo
036 12.2 L
037 12.5 My
037 12.4 El

SX CYG
201130
033[13.1 Pt
041[13.1 B

RT SGR
201139
003 13.0 Bl
009 12.3 Bl
011 12.1 En

WX CYG
201437b
005 11.0 Ch
009 11.0 Cy
015 10.7 Jo
016 11.1 Cy
017 11.3 L
026 11.4 Cy
028 11.4 L
029 11.3 Jo
033 11.5 Pt
034 11.7 Jo
034 11.0 Wd
035 11.8 Md
036 11.6 Jo
037 11.7 L
040 11.6 Jo
041 11.5 B
042 11.6 Cy

V SGE
201520
039 11.9 Me
039 10.6 Jo
040 11.6 Me
041 11.9 Me
044 11.7 Me
045 11.6 Me

U CYG
201647
008 10.6 Ch
014 11.3 Ko
015 9.2 Jo
026 9.7 Sh
029 10.7 Ko
029 10.0 Jo
033 10.0 Pt
034 9.9 Jo
034 9.9 Wd
035 10.1 Mc
035 10.3 Md
035 10.1 GD
037 9.5 Jo
039 10.5 Ko
040 9.4 Jo
041 9.6 B
042 10.2 Mn
047 9.6 Wd
050 9.9 Wd
050 9.9 Hf

U MIC
202240
003[13.6 Bl

RU CAP
202622
042 9.6 B

Z DEL
202817
033 13.5 B
034 13.5 L

ST CYG
202954
007 13.8 Ch
028 13.7 L
033 13.5 Pt
034 13.3 B
037 13.3 L

V VUL
203226
033 8.6 Pt

R MIC
203429
986 12.4 Bl
003[12.8 Bl

Y DEL
203611
033 13.7 B
034 13.9 L

S DEL
203816
005 9.1 Ch
014 9.0 Jo
030 9.2 Jo
032 8.9 Sz
033 8.8 Pt
033 9.0 Hu
034 8.7 Jo
035 9.1 Md
037 8.8 Jo
040 8.7 Jo
044 8.7 B

V CYG
203847
008 13.0 Ch
015 12.0 Jo
028 12.1 L
029 12.0 Ko
033 12.3 Pt
034 11.2 Jo
037 10.9 Jo
037 11.6 L
039 11.6 Ko
040 10.5 Jo
041 10.5 B

Y AQR
203905
018 12.5 An
030 11.2 Jo
032 10.8 Jo
033 11.2 B
033 10.9 Pt
034 10.6 Jo
037 10.3 Jo

T DEL
204016
005 11.5 Ch
016 10.2 Cy
018 9.8 L
026 9.2 Cy
030 9.5 Jo
032 9.2 Jo
032 9.3 Wa
033 9.3 Pt
034 9.2 Jo
036 9.0 L
037 9.0 Jo
040 8.7 Jo
042 9.2 Cy
044 9.3 B

V AQR
204102
015 8.7 L
033 9.3 Pt
035 9.3 Md
036 9.4 L
037 9.4 Me
039 9.5 Jo

W AQR
204104
018 14.0 L
037 13.7 L

U CAP
204215
975 11.3 Ch
986 11.6 Bl
003 11.9 Bl
008 12.4 Ch
009 12.1 Bl
018 13.4 L
034 13.8 L

V DEL
204318
008[13.1 Ch
034[13.9 L

T AQR
204405
008 7.8 Ch
014 8.0 Jo
015 8.2 Mn
018 8.2 An
026 8.7 Ah
029 7.8 Jo
029 8.2 Mn
033 8.4 Pt
034 8.0 Sq
034 8.2 Jo
037 8.3 Jo
037 8.5 Me
039 8.2 Sq
040 8.5 Jo
041 8.8 Ah
042 8.7 Mn

RZ CYG
204846
033 12.6 Pt
034 11.8 B
039 11.7 Jo

S IND
204954
986 9.1 Bl
999 9.4 Ht
003 9.2 Bl
009 9.4 Bl
011 9.5 Ht

X DEL
205017
008[13.2 Ch
034 14.4 L

R VUL
205923a
034 9.1 B
034 8.4 Jo
035 9.1 My
035 9.0 Md
037 9.5 Me
040 8.7 Jo
041 9.7 Ah

V CAP
210124
003[13.2 Bl
038[13.7 L

TW CYG
210129
008[13.8 Ch
034 14.4 L

X CAP
210221
986 11.8 Bl
003 12.4 Bl
033[12.4 Pt

X CEP
210382
004[13.9 Br

RS AQR
210504
018 12.5 L
033 13.2 Pt
033 13.1 B
036 12.9 L

Z CAP
210516
975 9.8 Ch
018 13.0 L
034 13.5 L
034 13.7 B

R EQU
210812
004 10.6 Br
018 9.6 L
033 8.9 Pt
034 8.7 B
036 8.7 L
042 9.3 BL
043 9.2 BL
050 9.4 BL

T CEP
210868
973 8.8 Ch
009 8.0 Ch
014 7.1 Jo
014 7.9 Mn
019 7.8 Mn
024 7.5 Oy
024 6.9 Ko
026 7.2 Me
026 6.6 Sh
029 6.7 Sh
029 6.8 Jo

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1932.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

T CEP
210868
029 7.4 Mn
030 7.4 Ah
032 7.0 Sq
033 6.9 Pt
033 7.0 El
034 6.7 To
034 6.9 Wd
034 6.8 Sh
035 7.0 El
036 6.7 Ko
037 7.7 Oy
039 6.5 Jo
039 6.8 Sq
040 7.2 Hf
040 6.9 Sh
041 7.5 Oy
041 7.5 Ra
041 7.5 Ah
042 6.9 El
042 7.3 Mn
043 7.5 Ra
044 7.5 Ra
044 7.1 Hf
044 6.9 Sh
046 7.5 Ra
050 6.9 Sh

RR AQR
210903
008 13.4 Ch
033 14.1 B
034 14.4 L
039 14.1 Bw

Y PAV
211570
997 6.0 Ht
011 5.9 Ht

X PEG
211614
018 11.8 L
033 12.4 Pt
034 12.7 L
041 12.8 B

T CAP
211615
975 12.9 Ch
037 13.5 L

S MIC
212030
003[13.4 Bl
011[12.4 En

Y CAP
212814
009 13.3 Bl
028 11.4 L
037 10.6 L
042 11.3 B

W CYG
213244
018 6.5 L
034 6.5 L
041 5.9 Oy

S CEP
213678
009 10.4 Ch
015 8.6 Jo
016 9.9 Cy
029 8.7 Jo
031 10.2 Me
033 9.8 Pt
033 10.1 Wr
034 8.6 Jo
035 10.5 Md
039 8.4 Jo
042 9.9 Cy
043 9.6 Wa

RU CYG
213753
016 8.7 Cy
018 9.3 Ry
018 8.8 Je
026 9.0 Cy
031 9.6 Me
032 8.9 Jo
033 9.5 Je
033 9.5 Ry
033 9.0 Pt
034 9.0 Jo
036 9.0 My
037 10.1 Je
040 8.8 Jo
040 9.7 Ry
042 9.7 Ry
042 9.3 Cy

RV CYG
213973
033 6.6 Pt

RR PEG
214024
009 13.9 Ma
033 12.5 Pt
035 11.6 Md
042 10.8 B

R GRU
214247
999 10.1 En
999 10.3 Ht
003 9.5 Bl
009 9.0 Bl
011 9.3 En
011 9.3 Ht

V PEG
215605
018 10.7 L
033 11.2 Pt
036 11.7 Wa
036 11.8 L

V PEG
215605
041 11.8 B

U AQR
215717
018 11.7 L
033 11.9 Pt
036 11.2 L

RT PEG
215934
009 13.8 Ma
041 11.0 B

RY PEG
220133a
032 12.8 Bw
033 12.1 Pt
036 12.7 Bw
038 12.8 Bw
041 12.9 B
042 12.7 Bw
045 12.5 Bw

RZ PEG
220133b
018 12.6 L
032 12.7 Bw
036 12.6 Bw
036 12.7 L
041 12.7 B
042 12.7 Bw
045 13.1 Bw

T PEG
220412
034 14.2 L
040 14.0 Bw

Y PEG
220613
033[12.5 Pt

RS PEG
220714
018 10.3 L
033 10.8 Pt
035 10.7 Md
036 10.8 L

T GRU
221938
999 10.1 En

S GRU
221948
999 7.8 En
999 8.1 Ht
011 8.7 Ht
011 8.3 En

RV PEG
222129
034 14.0 L

S LAC
222439
026 9.7 Ko
033 9.6 El
033 10.0 Pt
034 9.2 Wr
035 9.4 Md
036 9.0 Ko
036 9.2 L
039 9.2 El
042 9.2 Cy
042 8.7 BL
043 8.9 BL
047 8.4 B
050 9.0 BL

R IND
222867
003 13.5 Bl
009 13.0 Bl

T TUC
223462
999 12.3 Ht
011 13.0 Ht
011 12.8 En

R LAC
223841
033[12.4 Pt
036 13.5 L

RW PEG
225914
009 14.1 Ma
018 14.2 L
037[13.8 L

β PEG
225927
030 2.5 Mc
035 2.6 Mc

R PEG
230110
033 9.8 Pt
034 9.3 Jo
035 9.8 Wd
035 9.8 Hf
036 10.0 Sf
037 9.6 GD
042 10.1 Hf
043 10.2 Sf

V CAS
230759
973 8.8 Ch
001 10.9 Ch
016 11.1 Cy
026 11.4 Cy
031 11.8 Me
032 11.5 Ko
033 11.6 Pt
033 11.6 El
039 12.2 El
042 12.0 Cy
042 11.8 B

W PEG
231425
018 12.0 L
032 11.5 Jo
032 12.2 Bw
036 11.6 L
040 12.3 Bw
042 11.4 Cy

S PEG
231508
017 9.7 L
026 9.3 Cy
033 9.0 Wr
033 8.3 Pt
035 8.5 Br
036 8.6 My
036 8.8 L
037 9.0 Je
039 9.0 Je
041 8.7 Ah
042 8.7 Cy

RY CEP
231878
009 9.7 Ch

V PHE
232746
999 11.8 En
999 11.8 Ht
011 12.6 Ht
011 12.3 En

Z AND
232848
001 10.9 Ch
009 10.6 Ma
015 10.5 Cy
026 10.6 Cy
032 10.6 Co
032 10.5 Eb
032 10.7 Bw
032 10.8 Ko
033 10.7 Pt
035 10.7 Md
036 10.7 Wa
042 10.3 Cy

ST AND
233335
016 10.5 Cy
016 10.0 Jo
029 9.7 Lg
030 10.0 Jo
031 10.0 My
033 9.6 Pt
038 10.0 My
042 9.3 Cy
042 9.8 BL
043 9.7 BL
043 8.9 Lg
045 9.8 My
050 9.3 Lg
050 9.5 BL

R AQR
233815
973 8.0 Ch
986 8.0 Bl
999 8.0 Ht
003 8.5 Bl
009 8.3 Bl
009 8.6 Ma
011 8.4 Ch
011 8.1 Ht
013 8.1 We
014 8.4 Jo
017 7.9 An
017 7.9 Be
017 8.7 L
018 8.1 Bc
024 8.4 Bc
028 8.2 L
029 8.6 Ko
029 8.5 Jo
031 8.5 Me
032 8.1 Bc
033 8.4 Bc
033 8.5 Pt
033 8.4 Sq
034 8.6 Sq
034 8.4 Jo
036 8.4 Jo
036 8.4 Bc
036 8.3 Bf
036 8.5 Ko
037 8.1 L
039 8.6 Sq

Z CAS
233956
001 10.4 Ch
017 10.8 L
032 11.5 Bw
035 11.3 Br
036 11.3 Wa

RR CAS
235053
033 10.8 Bn
040 10.8 Bn

V CET
235209
009 13.6 Bl

R TUC
235265
999[13.3 Ht
011[12.9 En

R CAS
235350
988 11.4 Ch
014 10.5 Mn
016 10.3 Jo
023 10.8 B
029 10.6 Jo
034 11.6 Wd
050 11.1 Wd

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1932.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R CAS	Z PEG	W CET	Y CAS	SV AND	SV AND
235350	*235525*	*235715*	235855	235939	235939
050 11.2 Hf	036 11.2 L	611 10.8 Ch	001 12.5 Ch	001 10.8 Ch	018 10.3 An
Z PEG	036 10.5 Wa	014 11.3 Wr	038[14.2 L	009 10.8 Ma	036 8.5 Bw
235525	041 10.0 Gy	034 12.5 Wr	042[13.9 B	016 10.5 Cy	042 7.8 Cy
017 11.3 L					

RAPIDLY VARYING IRREGULAR VARIABLES.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.	Star	J.D.	Est.Obs.	J.D.	Est.Obs.
005840 RX ANDROMEDAE—					074922 U GEMINORUM—				
	7010.1	12.5 Ch	7037.7	11.9 Pt		7039.9	14.0 El	7043.7[	12.4 Cy
	7018.6	12.6 Ry	7038.8	11.8 Pt		7040.8[	12.8 Me	7046.7[	12.4 Me
	7026.6	12.1 Me	7039.6	11.3 Ko		7041.6[	12.4 Gy	7047.7[	12.4 Me
	7029.5	12.3 Ko	7039.7	11.4 Me		7042.6[	12.4 Cy	7048.7[	12.5 Me
	7030.6	11.6 Me	7039.8	11.7 Pt	071473 Z CAMELOPARDALIS—				
	7031.6	11.4 Me	7040.5	11.6 Ry		7012.7	12.1 L	7036.4	11.4 L
	7032.5	11.3 Ko	7040.6	11.7 Me		7014.3	11.8 L	7036.6	11.4 Ko
	7032.7	11.3 Me	7040.7	11.8 Pt		7014.7	11.8 L	7036.7	11.7 L
	7033.5	11.1 Ry	7041.7	11.4 Gy		7015.3	11.6 L	7036.8	11.2 Pt
	7033.7	11.5 Pt	7041.7	11.6 Me		7015.6	11.9 L	7037.4	11.6 L
	7034.6	11.7 Me	7042.5	12.0 Ry		7015.7	11.2 Cy	7037.6	11.5 Me
	7034.6	11.6 Ko	7042.7	11.8 Pt		7016.3	11.5 L	7037.7	11.3 Pt
	7034.7	11.7 Pt	7043.7	11.5 Me		7016.7	11.7 L	7037.7	11.6 L
	7034.7	11.5 Br	7044.6	11.8 Me		7017.7	11.7 L	7038.2	11.6 L
	7035.6	11.9 Me	7045.6	12.0 Me		7018.3	11.6 L	7038.8	11.3 Pt
	7035.6	11.7 Ko	7046.7	11.4 Me		7018.6	11.7 L	7039.6	11.9 Ko
	7035.7	11.6 Br	7047.7	11.3 Me		7021.9	12.0 Cy	7039.7	11.5 Me
	7036.8	11.7 Pt	7048.7	11.3 Me		7026.2	11.6 L	7040.6	11.7 Me
	7037.6	11.9 Me	7049.6	11.7 Me		7026.6	11.5 Me	7040.7	11.7 Pt
060547 SS AURIGAE—						7028.3	11.9 L	7041.6	12.0 Gy
	7009.7[	12.5 Cy	7033.8	13.2 El		7029.5	12.0 Ko	7041.7	11.9 Me
	7010.2[	13.2 Ch	7034.3	13.7 L		7030.6	11.6 Me	7041.9	11.7 Pt
	7011.7[	12.5 Cy	7034.6	13.4 Wa		7031.6	12.3 Me	7042.7	11.7 Pt
	7012.7	14.5 L	7034.7	14.0 Bw		7032.7	11.8 Me	7043.7	11.7 Cy
	7014.7[	13.9 L	7034.7	13.2 Me		7033.7	11.5 Me	7043.7	11.7 Me
	7015.7	14.4 L	7035.3	13.7 L		7033.8	11.8 Pt	7044.6	11.7 Me
	7016.3	14.3 L	7036.4	13.9 L		7034.3	11.5 L	7045.6	11.6 Me
	7016.7	14.4 L	7036.7	13.7 L		7034.6	11.4 Ko	7046.7	11.3 Me
	7017.7	14.5 L	7037.4	14.0 L		7034.6	11.4 Me	7046.9	11.8 Cy
	7018.7	14.5 L	7037.7	14.4 L		7035.3	11.3 L	7047.7	11.5 Me
	7021.9[	12.5 Cy	7038.3[	13.9 L		7035.6	11.4 Me	7048.7	11.9 Me
	7024.4[	11.5 Ry	7039.6[	12.5 Jo		7035.6	11.4 Ko	7049.6	11.6 Me
	7026.7[	11.0 L	7040.6[	12.8 Me		7035.7	11.6 L		
	7027.3	10.8 L	7041.9[	12.6 Pt	094512 X LEONIS—				
	7030.6	11.5 Me	7042.6	14.2 Bw		7036.8[	12.6 Pt		
	7031.6	11.8 Me	7043.6[	13.3 Wa	202946 SZ CYGNI—				
	7032.6	12.8 Ie	7044.6[	12.5 Me		7026.7	9.3 Pt	7039.8	9.2 Pt
	7932.7	12.1 Me	7045.6[	12.5 Me		7033.7	8.9 Pt	7040.7	9.4 Pt
	7033.7	12.9 Me	7046.7[	12.5 Me		7036.8	9.2 Pt	7042.7	9.8 Pt
	7033.7	12.8 Pt				7037.7	9.2 Pt	7054.7	9.1 Pt
074922 U GEMINORUM—						7038.8	9.0 Pt		
	7012.7	14.0 L	7033.7[	13.5 Me	213843 SS CYGNI—				
	7014.7	13.9 L	7034.7[	13.5 Me		6974.1	11.7 Ch	7008.6	8.7 Ae
	7015.7	13.9 L	7035.7	13.8 L		6985.7	11.7 Br	7009.7	8.8 Ae
	7016.7	14.0 L	7035.9	13.6 El		6991.0	11.5 Ch	7009.8	8.6 Ma
	7017.7	14.1 L	7036.7	14.1 L		6998.7	8.1 Br	7010.2	8.8 Ch
	7021.9[	12.4 Cy	7037.7	14.1 L		7002.1	8.3 Ch	7010.7	8.8 Ae
	7026.7[	10.9 L	7037.8	14.0 El		7004.7	8.4 Br	7011.7	8.9 Ae
	7032.7[	13.5 Me	7038.8[	12.4 Pt		7007.2	8.7 Ch	7013.6	9.1 We

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1932.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
213843 SS CYGNI—							213843 SS CYGNI—						
	7013.6	9.9	Ko	7028.5	12.0	Ha		7035.6	11.9	Md	7040.6	12.1	Wa
	7014.2	9.9	L	7029.5	12.2	Wa		7035.6	12.1	Wa	7040.6	11.8	Me
	7014.6	10.6	Ko	7029.6	12.0	Ko		7035.6	11.8	Me	7040.6	11.7	Jo
	7014.7	10.3	Ae	7030.4	11.8	Ah		7035.6	12.0	Ko	7040.7	11.7	Pt
	7014.8	9.7	Ma	7030.6	11.9	My		7035.7	12.0	Br	7041.2	12.0	Ah
	7015.2	10.0	L	7030.6	11.8	Me		7035.7	11.9	Hu	7041.6	12.0	B
	7015.6	10.7	Ae	7030.6	12.0	Jo		7036.3	12.1	L	7041.7	11.9	Me
	7015.6	9.8	We	7031.5	11.8	My		7036.5	12.0	Bf	7042.5	12.0	Cy
	7015.6	11.0	Jo	7031.6	11.9	Me		7036.5	12.0	Bc	7042.5	12.0	El
	7015.7	10.7	Cy	7032.5	12.1	Wa		7036.5	11.8	My	7042.6	12.2	Wa
	7016.2	10.5	L	7032.6	12.0	Bc		7036.5	12.1	Wa	7042.7	11.7	Pt
	7016.6	11.0	Cy	7032.6	12.0	Sz		7036.5	12.1	Ko	7043.5	11.9	Cy
	7016.6	11.5	Jo	7032.6	11.9	Jo		7036.6	12.0	Jo	7043.6	12.2	Wa
	7017.2	11.2	An	7032.7	12.0	Me		7036.8	11.7	Pt	7043.7	12.1	Me
	7017.2	11.5	Be	7033.6	12.0	El		7037.3	12.1	L	7044.6	11.9	Me
	7017.2	10.9	L	7033.6	12.0	Bc		7037.5	11.9	El	7044.6	12.0	B
	7018.2	11.6	An	7033.7	11.9	Hu		7037.5	11.7	My	7045.5	11.9	My
	7018.3	12.0	L	7033.7	11.7	Pt		7037.6	11.8	Me	7045.6	12.1	Me
	7018.6	11.8	Bc	7033.7	11.8	Me		7037.7	11.7	Pt	7046.7	12.2	Me
	7022.5	12.0	Cy	7034.3	12.1	L		7038.2	12.2	L	7047.6	12.0	B
	7022.7	12.1	Ma	7034.6	12.0	B		7038.5	11.7	My	7047.6	12.0	Wd
	7022.8	12.1	Ae	7034.6	11.9	Ae		7038.6	12.2	Wa	7047.7	11.8	Me
	7024.5	11.8	Bc	7034.6	12.0	Wa		7038.8	11.5	Pt	7048.6	11.9	Wa
	7025.6	12.0	Cy	7034.6	11.9	Wd		7039.5	11.9	El	7048.9	11.9	Me
	7026.5	12.2	Cy	7034.6	11.8	Me		7039.6	11.9	Jo	7049.6	12.1	Me
	7026.6	12.3	Me	7034.6	11.8	Jo		7039.6	12.0	Ko	7050.6	11.8	Hf
	7026.7	11.8	Pt	7034.6	12.1	Ko		7039.7	11.8	Me	7050.6	11.8	Wd
	7027.5	12.0	Ko	7034.7	12.0	Br		7039.7	12.0	Ae	7054.7	9.0	Pt
	7028.3	12.3	L	7035.3	12.1	L		7039.8	11.8	Pt	7057.6	9.7	Wa
	7028.5	12.0	Bc	7035.6	11.9	My		7040.5	11.8	Sf	7057.6	9.7	Jo

SUMMARY FOR DECEMBER, 1932.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Ahnert	Ah	29	54	Houston	Hu	8	9
Allen, L. B.	Ae	1	9	Jansen	Je	13	29
Ancarani	An	19	20	Jones	Jo	119	381
Baldwin, J. M.	Bl	87	185	Iedema	Ie	2	2
Benini	Be	6	7	Kohman	Ko	41	102
Bigelow	Bw	27	41	Lacchini	L	165	389
Boutell	BL	12	34	Logan	Lg	8	13
Bouton	B	65	69	Marsh	Ma	14	16
Brocchi	Br	6	13	McLeod	Mc	18	38
Brown, A. N.	Bn	4	9	Meek	Me	102	272
Buckstaff, E.F.	Bf	4	4	Mennella	Mn	17	51
Buckstaff, R.N.	Bc	4	17	McKnelly	My	22	48
Bunting	Bg	2	11	Millard	Md	12	12
Chandra	Ch	148	174	O'Byrne	Oy	10	25
Cilley	Cy	33	90	Peltier	Pt	197	262
Cole	Co	11	11	Raphael	Ra	2	15
Ebert	Eb	9	9	de Roy	Ry	7	15
Eliason	El	55	116	Schenkman	Se	6	11
Godfrey Club	GD	6	9	Shinkfield	Sl	19	40
Gregory	Gy	31	31	Shultz	Sz	5	5
Hanseter	Ha	2	2	Smith, F. P.	Sq	5	10
Hartmann	Hf	21	39	Smith, F. W.	Sf	6	8
Houghton	Ht	51	87	Smith, L.	Sh	6	19

SUMMARY FOR DECEMBER, 1932—Continued.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Watson	Wa	10	21	Wright	Wr	9	10
Webb	Wd	24	55				
Wetherbee	We	18	21	Totals	51	418	3006

LEON CAMPBELL, Recorder.

January 10, 1933.

Meteor Notes from the American Meteor Society

By CHARLES P. OLIVIER, President

The year 1932 may have been one of general depression and hard luck for many institutions, but it was quite the opposite for the American Meteor Society. With excellent reason, we had been pleased with the great increase of interest and number of observations in 1931 over any previous year, but the total already received here for 1932—and more are undoubtedly on the way—has doubled that of last year. In fact over 58,000 observations of all kinds have arrived, from meteors counted in half-hour intervals during a shower to those fully described on the standard record sheet and carefully plotted on the regular maps.

It is hard for anyone not familiar with the subject to realize the tremendous outlay of energy necessary to gather so many data. Including all who aided in the counts on nights of showers and those who reported fireballs, it may be assumed that considerably more than one thousand persons took part. These people not only added something of value to science, but also had the educational advantage of personally taking part in the work, having their interest aroused, and perforce gaining practical experience in observing.

Only in the reports of telescopic meteors we find an actual decrease. This can mean but one thing: for such reports we have mostly to depend upon reports from persons not members of the A.M.S., and it seems impossible to secure their cooperation on a large scale, though earnest efforts have been made. It must be that observers, particularly our good friends in the A.A.V.S.O. who have most chances for seeing such objects, feel that it not worth their time to record telescopic meteors. Once more let us say that special blanks with instructions will be sent gladly to any who care to have them; and that even for the more assiduous observers, the amount of time needed to record all the telescopic meteors that any of them sees annually will not total one hour. Also these data have real value, and could we only get enough observers to coöperate, we would have the foundation for statistical studies on these little known bodies. Surely there are many observers who do not mind spending one hour a year in the gathering of such data. Will they not communicate with us and help out in 1933?

As to fireball reports, the total of objects runs about the same as last year. We now have state groups, with active leaders, in Arizona, Florida, Missouri, Oregon, Pennsylvania, and Texas, which are on the watch for great fireballs and make prompt efforts to gather data thereon, as well as on the more prominent showers. Apparently we have fewer reports from ships than in 1931, probably due to cloudy weather and moonlight at certain critical epochs.

Flower Observatory Reprints Number 12 and 13 were sent to all active members last year, and Number 15 is now ready for distribution. A new membership list will be prepared and mailed in the near future.

The great increase in our work has long since made it impossible for the writer to handle it alone. Two generous appropriations, available in September, 1932, have greatly aided: one of $400 from the J. Lawrence Smith Fund of the National Academy of Sciences, the other of $500 from the Research Committee Fund of the University of Pennsylvania. Thanks, in part, to these, the Flower Observatory has continued to have the valuable services of Mrs. Doris M. Wills, most of whose time is spent in preparation, study, and computation on records sent in by the A.M.S. Other members of the staff assist at intervals. We now have several papers on the subject of meteors or fireballs completed and awaiting publication. Others are being pushed on as rapidly as possible. A preliminary statistical discussion of 20,000 A.M.S. meteors observed in 1926 to 1932 was presented at the December meetings of the American Astronomical Society.

We desire to welcome as new members the following:

William Baines, Okanogan, Washington.
Stewart R. Baker, 535 W. Princess Street, York, Pennsylvania.
Barnard Astronomical Club of Hume-Fogg High School, Nashville, Tennessee.
Ed. F. Bowman, 2037 Poplar Avenue, Kansas City, Missouri.
David F. Brinegar, 1142 E 9 Street, Tucson, Arizona.
J. Brown (Probational), Pine Hills, Pass Christian, Mississippi.
G. Michael Bugarr, 1463 East 21st Street, Eugene, Oregon.
R. E. Cowdrick, Graysville, Tennessee. (Now at South Hall, Union College, College View Station, Lincoln, Nebraska.)
Armin Deutsch, 5524 Cornell Avenue, Chicago, Illinois.
Robert Deutsch, 1364 E. 52nd Street, Chicago, Illinois.
Vincent Francis, 25 Plymouth Street, New Bedford, Massachusetts.
Wayne B. Hales, Brigham Young University, Provo, Utah.
Wm. E. Hand, 124 Fourth Avenue, Cape May, New Jersey.
Edward Heyes, P. O. Prieska, N. W. Cape, South Africa.
Michael W. Holm, 2058 Palace Street, St. Paul, Minnesota. (Now at South Hall, Union College, Lincoln, Nebraska.)
Fred Kaempf, 3401 Avenue J, Brooklyn, New York.
Prof. Mohd. A. R. Khan, Begumpet, Deccan, N.S.R., India.
August Klapper, 727 Montgomery Avenue, Narberth, Pennsylvania.
Elmer Klapper, 727 Montgomery Avenue, Narberth, Pennsylvania.
Dr. J. H. Kusner, University of Florida, Gainesville, Florida.
Miss Louise M. Larrabee, 1061 Young Street, Honolulu, T. H.
Harold S. Martin, 11 Myrtle Street, East Norwalk, Connecticut.
David Molyneaux, 22 Murray Street, Binghamton, New York.
Walter S. Mory, 704 Pine Street, Waynesboro, Virginia.
Verne Robinson, 1020 Cleveland Avenue, Hobart, Indiana.
Harry M. Rouch, 1712 Champaign Avenue, Mattoon, Illinois.
Roger Rusk, 2505 Jefferson Avenue, Knoxville, Tennessee.
Leo J. Scanlon, Valley View Observatory, 106 Van Buren Street, Observatory P. O., Pittsburgh, Pennsylvania.
Alfred Schenkman, R. 2, New Brunswick, New Jersey.
Skyscrapers, R. I. Amateur Astronomical Society, Park Museum, Providence, Rhode Island.
Talbot Smith, Jr., (Probational), Box 457, R. 2, Tucson, Arizona.
Walter H. Wakefield, President, Aldrich Astronomical Society, Crompton & Knowles Loom Works, Worcester, Massachusetts.

The annual report is here presented in its usual form: Table I gives members' observations (most of these meteors were mapped); Table II, observations from non-members who report with some regularity (generally not mapped); Table III, Telescopic Meteors. The totals for the Perseid and Leonid Epochs are exclusive of 10,510 and 3,862 meteors reported for the Perseid and Leonid Epochs

respectively and included in Tables I and II. Of the 58,328 observations, about eighty per cent were made during the Perseid and Leonid dates.

The writer wishes to congratulate everyone who has so unselfishly aided in making 1932 the year of greatest achievement for the American Meteor Society, and to express the hope that 1933 may bring us even better success.

TABLE I.

Name	Station	Nights	Meteors
Alpha Nu Fraternity, Beta Chapter	Denver, Colorado	1	173*
Baker, S. R.	York, Pennsylvania	10	206
Bowman, E. F.	Kansas City, Missouri	5	854*†
Brinegar, D. F.	Tucson, Arizona	34	1789
Brown, J.	Pass Christian, Mississippi	2	46
Bugarr, G. M.	Eugene, Oregon	2	48*
Burns, H. A.	Spring Valley, New York	4	131
Clark, R. E.	Northfield, Minnesota	11	177
Cope, T. D.	Green Lane, Pennsylvania	1	64
Darling, B. C.	Pontiac and Ann Arbor, Michigan	6	49
Eason, F. B.	East Point, Georgia	6	510†
Edwards, Mrs. W. H.	Fairhope, Alabama	2	661*†
Evans, J. W.	Upper Darby, Pa., and McDaniel, Md.	3	104
Evons, M. L.	Yerkes, Pennsylvania	2	122
Francis, V.	South Dartmouth, Massachusetts	2	47
Geddes, M.	Otekura & New Plymth., New Zealand	15	694
Hett, J. H.	New Haven, Connecticut	1	169
Holm, M. W.	Lincoln, Nebraska	5	92
Ketchum, L. H.	Ontrim, Pennsylvania	1	405*
Khan, M. A. R.	Deccan, N. S. R., India	8	74*
Kingsbury, J. A.	Ulster County, New York	1	901*†
Klapper, A. and E.	Narberth, Pennsylvania	2	231*
Lawrence, A. S.	Lynbrook, L. I., New York	2	135
Logan, J. H.	New York City, New York	2	86†
Marsh, F. F.	Frederick, Maryland	6	168;
Martin, H. S.	East Norwalk, Connecticut	2	226
Martz, E. P.	Oak Park, Ill., and Fryeburg, Me.	2	52
McIntosh, R. A.	Auckland, New Zealand	19	719
Merkel, R. T.	Topton, Pennsylvania	1	94*
Miller, R. W.	Lansdowne, Pennsylvania	4	131
Molyneaux, D.	Binghamton, New York	3	156*
O'Byrne, S. L.	Webster Groves, Allenton and Ranken, Missouri	10	123
Olivier, C. P.	Green Lane and Upper Darby, Pa.	4	201
Persons, W. J.	Kalamazoo, Michigan	14	835‡
Ridley, G.	Alameda, Mt. Hamilton, and Mt. Diablo, California	9	1028§
Rosengarten, G.	Brookline, Pennsylvania	1	90*
Scanlon, L. J.	Pittsburgh, Pennsylvania	4	86†
Schenkman, A.	New Market & New Brunswick, N. J.	17	136
Shinkfield, R. C.	Adelaide, South Australia	6	99
Simpson, J. W.	Webster Groves, Missouri	29	501
Smith, F. W.	Glenolden, Pennsylvania	34	299
Smith, T., Jr.	Tucson, Arizona	15	359
Smith College Obs.	Northampton, Massachusetts	1	98*
Tomkins, T. K.	North Hills, Pennsylvania	6	104
Urquhart, Miss S.	Detroit, Manchester, and Fay Lake, Michigan	36	851
Wamer, W. P.	St. George, S. C., & Upper Darby, Pa.	4	297
Watson, Paul S.	Baltimore, Maryland	2	74
Williams, J. D.	Tucson, Arizona	111	5966
Wilson, R. H.	Upper Darby, Pennsylvania	3	152

TABLE I—Continued.

Name	Station	Nights	Meteors
Witherspoon, J. B.	Weatherford, Texas	2	148
Kusner, J. H., and Florida Group	Winter Park and Gainesville, Florida	2	496†
Bunch, S., and Tenn.-Ky. Group	Knoxville and Harrogate, Tennessee	4	213†
Texas Group	Fort Worth, Weatherford, and Hamilton, Texas	4	205†
Fifteen members reporting less than 40 each		25	343
			22,018

* Count or largely count.
† Group of observers, two or more.
‡ 221 of these by member alone.
§ Assistants on 726 of these. ; 71 of these with Miss L. B. Allen.

TABLE II.

Name	Station	Nights	Meteors
Miss L. M. Larrabee's Students	Honolulu, Territory Hawaii	10	97
Crow, H. C.	Grand Tower, Illinois	5	124
Hickerson, J. F.	Webster Groves, Missouri	21	317*
Simpson, A. M.	Webster Groves, Missouri	7	364
Missouri Group of Non-Members	Missouri and Illinois		1780
Reburn, Miss P., of Oregon Group	McMinnville, Oregon	2	43
Webster Groves Volunteer Group, 4 obs.	Sante Fe, New Mexico	2	306
			3,031

* Many plotted.

TABLE III.

TELESCOPIC METEORS.

Name	Station	Meteors
Aldwell, A. B.	San Francisco, California	5
Bouton, T. C. H.	St. Petersburg, Florida	5
De Roy, F.	Antwerp, Belgium	13
	Cambridge, Massachusetts	5
Flower Observatory	Upper Darby, Pennsylvania	24
Jones E. H.	Goffstown, New Hampshire	27
Marsh, F. F.	Frederick, Maryland	5
Simpson, J. W.	Webster Groves, Missouri	2
Smith, F. W.	Glenolden, Pennsylvania	7
Williams, J. D.	Tucson, Arizona	21
		114

1931 previously unreported telescopic meteors:

Dermul, A., Antwerp, Belgium	3
Tshernov, V., Ukraine, U. S. S. R.	3

Table I	22,018
Table II	3,031
Table III	114
Perseid Epoch	27,525
Leonid Epoch	5,409
Fireballs	231
Grand Total for 1932	58,328

Flower Observatory of the University of Pennsylvania,
Upper Darby, Pennsylvania, 1933 January 24.

Real Paths for Meteors (Second List)

By C. C. WYLIE

This is a continuation from the list published in these notes for October, 1932. The simultaneous observations were made at the University of Iowa Observatory, Iowa City, Iowa, and at Iowa Wesleyan College, Mt. Pleasant, Iowa. Wire reticles covering a circular area of sky 50° in diameter were used. Two reticles were set up at each station, one pointing toward the zenith, and the second at an altitude of 55° in the direction of the other station. During the period of the Leonid shower, watch was maintained by students on every night, but only November 15 was reasonably clear, and this was the only night on which simultaneous observations were secured. On this night four meteors were observed in duplicate, one of the four being recorded by two observers at each station. On the night of November 26, observations were made at Mt. Pleasant by R. E. Crilley assisted by Mr. Summers, and at Iowa City observations were made by C. C. Wylie assisted by Mr. Willis. Two meteors were observed in duplicate on that night. The results for the two nights are tabulated below, the times being 90th meridian and noon-to-noon reckoning, with the mile the unit of height and length. The radiants are not corrected for zenith attraction.

No.	Date Nov.	C.S.T. h m	Height Beg.	Height End	Proj. Length	Length	Radiant Alt. °	Radiant Az. °	Radiant R.A. °	Radiant Dec. °
6	15	15 19	56.5	44.0	13.7	18.5	42.5	135	33	57
7*	15	15 50	76.5	59.0	15.1	23.1	49.1	291	151	20
8*	15	16 05	78.3	50.0	22.9	36.4	51.0	292	153	19½
9*	15	16 31	74	69.5	3.2	6.4	59.6	297½	151	23
10	26	16 56	89.3	38.7	44.5	67.4	48.6	176½	124	82
11	26	17 09	75.0	47.0	39.1	48.1	36.2	88	81½	22

*Leonid.

The observations on the night of November 15 were made at both Iowa City and Mt. Pleasant by undergraduate students, competent, but with little previous experience in astronomical work. For Meteor No. 6, two observations were made at Iowa City and one at Mt. Pleasant. It was recorded "quite bright." The Mt. Pleasant observation indicates a lower end point than either of the Iowa City observations, and lower than that adopted. For Meteor No. 7 there are four observations, two at Iowa City and two at Mt. Pleasant. One of the Iowa City observations is, however, discordant, presumably because of an error in calling or recording the coördinates. There is no estimate of magnitude for this meteor, which was evidently a Leonid. For Meteor No. 8 there is one observation from each station. The great circle test is satisfied fairly well and the path should be reasonably near the truth. It was evidently a Leonid and there is no estimate of brightness. Meteor No. 9 was also recorded by one observer at Iowa City and by one at Mt. Pleasant. The height for either beginning or end is probably determined fairly well, but the length for so short a path has a rather large percentage of uncertainty. For all of these meteors on November 15 the bright moonlight without doubt made the height at which they were first noticed lower than would otherwise have been the case. This effect is especially noticeable on Meteor No. 6 which was recorded as "quite bright" although the height of appearance is less than 60 miles.

Meteor No. 10 was observed at Iowa City on November 26 by Willis, a grad-

uate student, and at Mt. Pleasant by Summers, an undergraduate student with experience observing the Leonids. This meteor was first magnitude, and the great circle test is satisfied for both beginning and end. Meteor No. 11 was a first magnitude meteor observed by R. E. Crilly at Mt. Pleasant, and by C. C. Wylie at Iowa City. The great circle test is satisfied for the end, but the Mt. Pleasant beginning is farther back. This is presumably because the recorder's light interfered with the Iowa City observer at that time. The figure adopted for height of appearance is therefore the height at which it was first observed from Mt Pleasant.

The computations have been carried through, but not checked, for the Leonids observed by our party in Arizona. We plan to publish the results at an early date in these notes.

University of Iowa, January 23, 1933.

The Leonid Shower as Seen November 16, 1932

These observations were made from 2:15 A.M. to 3:00 A.M. at New Haven, Connecticut, by an unscientific observer, facing due south. The sky was almost cloudless.

During the first quarter of an hour four brilliant Leonids, moving in a southwesterly direction, flashed across the sky. Then at 2:35 A.M., for perhaps three seconds, a breath-taking splendor swept through space apparently travelling in a southeasterly direction, right under Jupiter, causing it to look like a pin point. Judging by its transit across the window, and the observer's position relative to the window, its course must have covered about forty-five degrees. In apparent size this fireball seemed to be half the diameter of the full moon. It gleamed with all colors of the rainbow, blue being predominant, and it left a trail of sparks, like a rocket. The end of its flight was marked by a supreme burst of soft glory, which filled the observer with awe.

(Mrs.) M. H. Fisher.

460 Prospect Street, New Haven, Connecticut, December 10, 1932.

Leonid Observations at Madison, Wisconsin

Here are given the counts of meteors which were made in Madison on the night of November 15-16. The observations were made by about twenty-five members of two Astronomy classes and other interested persons under my supervision. The sky was clear after 10:00 P.M. except for very small clouds from Lake Mendota which did not interfere with the meteor counts. I am listing the numbers in half-hour intervals as follows:

C.S.T.	Meteors	Leonids
11:30 to 12:00	15	13
12:00 to 12:30	10	7
12:30 to 13:00	12	9
13:00 to 13:30	26	23
13:30 to 14:00	32	30
14:00 to 14:30	39	37
14:30 to 15:00	27	27
15:00 to 15:30	32	30
15:30 to 16:00	34	34
16:00 to 16:10	9	8
	236	218

Washburn Observatory, University of Wisconsin. C. M. Huffer.

Comet Notes

By G. VAN BIESBROECK

The year has started with no less than eight comets under observation. All of them are losing in brightness; several can only be reached by larger instruments and they now gradually fade beyond the reach of even these.

The brightest of all these comets is the most recently found object 1932 *n* (Dodwell-Forbes). While the first announcement concerning this object came from G. F. Dodwell at Adelaide (Australia) who reported the object on December 17, it was soon followed by the information that A. F. I. Forbes at Hermanus (Cape Colony) had discovered the object independently on December 15. Hence the double name given to this object.

It is well situated in the evening sky and had reached nearly eighth magnitude at the end of December; hence it has been abundantly observed. Several improved orbits have been computed. The following elements deduced by A. D. Maxwell (Ann Arbor, Michigan) from observations extending to December 30 are already a good approximation and his ephemeris will allow observers to follow the object.

Elements and Ephemeris of Comet 1932 *n*.

Time of Perihelion	T =	1932 Dec. 30.38869 U.T.
Node to perihelion	ω =	327° 7′ 39″.6
Longitude of node	Ω =	77 9 49.8 } 1933.0
Inclination	i =	24 39 1.2
Perihelion distance	q =	1.137895 A.U.

1933 0^h U.T.		α h m s	δ ° ′	Distance from Earth	Distance from Sun	M
Feb.	1	1 46 10	+12 11.5	1.018	1.252	9.4
	5	2 1 13	15 33.7			
	9	2 16 21	18 43.1	1.083	1.309	9.6
	13	2 31 34	21 38.5			
	17	2 46 51	24 19.3	1.165	1.374	9.8
	21	3 2 10	26 45.3			
	25	3 17 29	28 56.8	1.263	1.446	10.1
March	1	3 32 48	30 54.0			
	5	3 48 3	32 37.6	1.374	1.523	10.4
	9	4 3 12	34 8.3			
	13	4 18 12	35 27.0	1.497	1.603	10.7
	17	4 33 2	36 34.4			
	21	4 47 40	37 31.5	1.629	1.689	11.0
	25	5 2 3	38 19.0			
	29	5 6 11	+38 57.8	1.769	1.775	11.3

The position of the orbit relatively to that of the earth is shown in the diagram (Fig. 1). I have added the column M (magnitude) under the assumption that the brightness corresponded to that of a 9^M.0 star on January 19. That brightness was obtained by the writer from extra-focal comparisons with B.D. stars, the magnitude of which was reduced to the Harvard Scale. The same night a 20 minute exposure with the two-foot reflector brought out the fact that aside from the large round coma there was a long slender tail. Already on previous nights I had noticed visually that the coma was brightest on the west side of the coarse nucleus. The tail is evidently too faint for visual observations but on the original plate from which Figure 2 is enlarged it can be suspected as far as a degree from the nucleus in position-angle 68°, which is exactly opposite to the direction of the

sun. The tail is nearly straight and aside from its nearly thread-like axis a bundle of lateral straight streamers is indicated, the whole making, however, a narrow cone emanating from the nucleus. This fine structure is largely lost in the grain of the fast plate used and still more in the process of trying to reproduce such delicate features on paper.

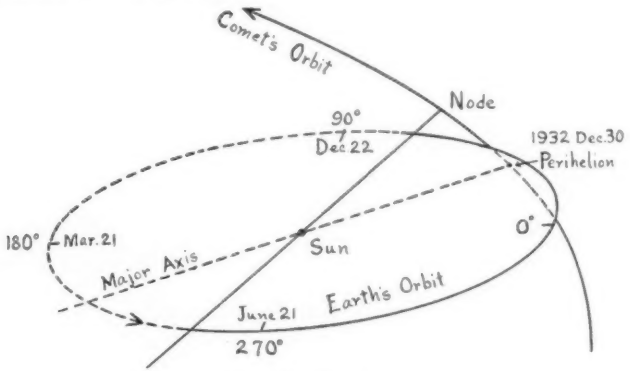

FIGURE 1.
ORBIT OF COMET DODWELL-FORBES.

The ephemeris shows that it will be easy to follow this comet for some time in the evening sky: in February it crosses the constellation of Aries, in March it passes through the southern part of Perseus and at the end of that month it will be found in Auriga but by that time it will have become quite faint.

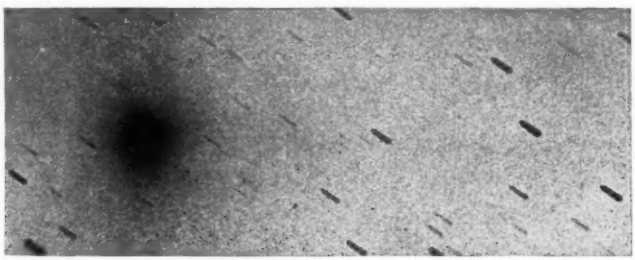

FIGURE 2.
COMET 1932 *n* (DODWELL-FORBES), JANUARY 20, 1933.

This apparition does not seem to be a return of any known comet. The periods obtained by several computers from the short interval of time covered by the measures are still extremely uncertain since there is no large deviation from a purely parabolic motion.

For the other comets that are kept under observation ephemerides were given last month. Little is to be said concerning these since they became very faint and most of them can be followed only by photography. There is, however, a striking exception.

COMET 1925 II (SCHWASSMANN-WACHMANN) the remarkable object that describes a nearly circular orbit between Jupiter and Saturn was first recorded at this opposition on December 26, both at Bergedorf (Germany) by R. Schorr and a few hours later at the Yerkes Observatory by the writer. We both estimated the magnitude as 17 on that date. On January 20 I again photographed the region in order to locate this faint object and found it as bright as 12th magnitude! Theoretically the brightness should have increased by less than one-tenth of a magnitude between the two dates. Several such enormous variations in brightness have occurred in this comet; no other comet has ever shown such outbursts. What makes these most exceptional is the fact that, the orbit being nearly circular, the distance from the sun hardly varies while the brightness increased a hundred fold. The observations are too scattered so far to show any regularity in the fluctuations of magnitude, and further watching is urgently needed. There is the lucky circumstance that this comet evidently can be observed all the way around its 16-year orbit, since it is now near aphelion. The present opposition is the fourth after the discovery in 1927, and the comet is now followed in its sixth year of observation not counting the fact that it showed already on a pair of plates taken at Heidelberg in 1902 as was recently found. The continuation of the ephemeris by J. G. Behrens is given here.

1933 0^h U.T.	α h m	δ ° ′	—Distance from— Sun	Earth
Feb. 1	9 16.6	+17 5	7.30	6.31
9	9 13.1	17 16		
17	9 9.7	17 26	7.30	6.34
25	9 6.5	17 36		
March 5	9 3.6	17 43	7.30	6.43
13	9 1.1	17 49		
21	8 59.0	17 53		
29	8 57.5	+17 54	7.30	6.70

The correction is small, only $+0^m2$ in right ascension and $-3'$ in declination.

In the morning sky COMET 1932 *g* (GEDDES) continues to be well in reach since it can be seen at higher altitudes, and, as its brightness is not changing much, Bobone's ephemeris given in the December number is continued here as follows:

EPHEMERIS OF COMET 1932 *g* (GEDDES).

1933 0^h U.T.	α h m s	δ ° ′	——Distance—— from Sun	from Earth	M
Feb. 2	15 13 50	— 3 12.5	2.75	2.64	9.8
10	15 11 11	— 0 2.4	2.80	2.53	9.8
18	15 6 39	+ 3 30.5	2.85	2.43	9.7
26	14 59 58	7 25.4	2.90	2.35	9.7
March 6	14 50 59	11 38.1	2.95	2.28	9.7
14	14 39 41	16 0.7	3.01	2.24	9.7
22	14 26 9	20 22.3	3.06	2.24	9.7
30	14 10 44	24 29.7	3.12	2.26	9.8
April 7	13 54 5	28 10.3	3.17	2.32	9.9
15	13 36 57	31 15.4	3.23	2.40	10.0
23	13 20 13	33 41.5	3.29	2.52	10.1
May 1	13 4 40	+35 29.2	3.35	2.66	10.3

During the month of February the comet passes from Libra into Boötes. On a plate taken here December 26 the magnitude comes out about $10\frac{1}{2}$; the coma has a diameter of about $3'$ and it is strongly condensed in the center. Besides there is a tail recorded over a length of $15'$ in position-angle 160°. The comet has now

been followed for seven months and from all appearances it will remain visible for several months longer.

The search for PERIODIC COMET PONS-WINNECKE which comes to perihelion this spring has not revealed its presence so far but the object may be expected before long. The continuation of the search-ephemeris computed by Crommelin under two assumptions for the time of perihelion will help in locating the comet: (*British Astr. Assoc. Handbook* for 1933).

1933 0^h U.T.	*T* assumed May 15.0		*T* assumed May 21.0	
	h m s	° ′	h m s	° ′
Feb. 2	15 10 13	+8 27	14 55 54	+10 26
8	15 27 16	8 14	15 11 43	10 26
14	15 45 01	8 02	15 28 18	10 27
20	16 03 43	7 51	15 45 30	10 33
26	16 23 15	7 41	16 03 40	10 39
Mar. 4	16 43 42	+7 31	16 22 32	+10 46

Williams Bay, Wisconsin, January 21, 1933.

Notes from Amateurs

Amateur Telescope Makers of Chicago

At the regular monthly meeting of the Amateur Telescope Makers of Chicago, held at the Adler Planetarium on January 8, Professor Arthur Howe Carpenter was the speaker. His subject was mirror-making by hand and by machine. He gave a brief history of the art of polishing stone, glass, and metals, explaining the molecular changes which take place on the surfaces of steel and glass during the grinding and polishing processes. He described the machine which he constructed and is using on his 20½-inch mirror, the use of the lead lap for rough grinding and the adjustments which can be made on the machine for different strokes and the general flexibility of the machine.

Mr. Leroy M. Clausing demonstrated his precision clock drive which has a slow speed of 78.261 R.P.M. Mr. Clausing had a special reduction train on the machine but it can be used with belt reductions.

A resolution was passed expressing regret because of the death of the Treasurer, Mr. Arthur Pursell, who was killed in an automobile accident near Goshen, Indiana, on December 24.

WM. CALLUM, *Secretary*.

Astrolab

The launching of the Astrolab Program and the enthusiastic responses to the "Who's Who Questionnaire" of last month have been so spontaneous that with practically no organization Astrolab is already functioning.

At the time of publishing the last Astroscope we estimated that probably less than twenty per cent of the two hundred organization issues sent out would be answered. However, the replies have already exceeded our expectations, and we now feel that over half the leading amateurs, whose addresses we had, have responded.

Eyepiece, Prism, and Diagonal Committee. Thanks to the coöperation going on between amateurs in Omaha, Northeast Michigan, Pittsburgh, Chicago, Erie, Louisville, and Tacoma, quarter and one-and-one-half inch foci have been added to the five eyepieces already under development.

Prisms. Many amateurs have been having difficulty getting a sufficiently large prism of good quality at an economical price. Furthermore, many whose instruments we have seen use a prism that is too small to get the entire benefit of their mirror under low power. For example, if eyepiece field lens is 1¼-inch diameter, a 6-inch mirror of standard 36-inch focus with focal plane 4 inches from axis of tube requires a diagonal of 1⅞ inches (across the shortest diameter). Accordingly, we expect to secure silvered and laquered optical flats 1¾x2¾ inches and larger. These will be cut from flats of larger size to avoid the difficulty of turned down edge. Some are now under test. The cost will be considerably less than for prisms of equal efficiency.

Slide Department. It all started because one enthusiastic advocate of popularizing Astronomy, Dr. C. L. Hess, is to give a talk on "Astronomy as a Hobby" before the "Saginaw Valley Torch Club" of Northeast Michigan, February 7. An effort to gather information for this program resulted in the idea of exchanging developments among amateurs through the medium of projection slides. Amateurs in various cities in touch with Astrolab began to look around not only for subject matter for slides but also for a suitable projection machine.

A post card projector was investigated as a possible substitute for a slide projector as pictures are less expensive, easier to obtain, and can be projected in colors more readily than slides. As a result two different designs of projectors are now under way.

Over three hundred slides have already been listed by Astrolab, and mimeographed lists will eventually be supplied. Arrangements are being made through the Committee on Photography to make slides for other amateurs at an attractive price. Those having pictures of particular features of their telescope which are of advanced design can thus pass on their developments to other amateurs who are not quite so far along, or have not had that particular viewpoint of the problem—"One picture is worth 10,000 words."

We are investigating the market for a supply of condensers and projecting lenses in order that groups or individuals may make their own optical equipment and at the same time gain added information of optical laws. This sudden advanced development should be of considerable value.

It is hoped that a temporary lineup of Astrolab committees will be complete by March 1, which will function for six months on a trial setup before having organization take permanent form.

Dr. Dustheimer of Baldwin-Wallace College broadcasts a program on "Astronomy" the first evening of each month at 6:30 P.M., E.S.T., over WTAM, Cleveland.

The organization issue of the "Astroscope" will be sent you on request and the receipt of a stamped self-addressed envelope. Correspondence is invited by the members of "Astrolab" and the staff of the "Astroscope."

L. I. Buttles, Editor, "The Astroscope."
10728 S. Artesian Avenue, Chicago, Illinois.

The Skyscrapers

The Skyscrapers Amateur Astronomical Society of Rhode Island met on December 7, 1932, in Wilson Hall, Brown University. Mr. Leon Campbell of Harvard College Observatory delivered the address of the evening, "Practical Observing for Amateurs." As a result of the interest aroused by Mr. Campbell's talk, a number of the members have undertaken regular observing programs.

The next meeting of the Skyscrapers was held on January 2, 1933, at which time Professor Leah B. Allen, Director of Williams Observatory of Hood College, lectured on "Other Planets." Miss Allen's unusually lucid and interesting account of the major planets was received with great enthusiasm.

The members were invited to Ladd Observatory on the evening of January 25, 1933, to see a number of celestial objects through the 12-inch refractor. At the February meeting, Mrs. C. H. Smiley will speak on "The Spring Constellations."

Eclipse Observations by Amateurs

Present at Fryeburg, Maine, during the eclipse of August 31 was a group of amateurs from Oak Park, Illinois, consisting of Mr. Ray C. Soliday, Mr. Edwin P. Martz, Jr., Mr. Truman Kirkpatrick, and Mr. Alfred Mason. We were situated at Indian Acres, directly opposite the Dearborn Observatory expedition. Our instruments were: a three foot spectrograph, two coronal cameras, and a small refracting telescope, all being of amateur construction, exclusive of the lenses, by Mr. Martz and Mr. Kirkpatrick. The coronal photographs enclosed are respectively, a four second exposure of the corona and an enlargement of the same negative. While blurred, partially due to haze and inaccurate focus, these prints establish the sun-spot minimum, or medium type of corona, with "winged" limbs, and flattened poles. Four similar coronagraphs were secured, and the phases and chromospheric spectrums were photographed. Thanks are due Professor Edwin Brant Frost of Yerkes Observatory, and Dr. Oliver J. Lee of Dearborn Observatory for their advice so freely given.

EDWIN P. MARTZ, JR.

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Zodiacal Light Notes

By W. E. GLANVILLE

Evening Zodiacal Light. Mr. A. F. I. Forbes, Hermanus, South Africa, reports an observation at 9:25 P.M., November 28. Horizon breadth, 15°; main body of Light south of ecliptic: the north boundary passed just south of Pi and thence to the horizon west of Mu in Sagittarius; the south boundary passed just south of Zeta and Delta in Sagittarius, and the apex was about 5° east of Chi in Sagittarius. The Light was faint.

On December 27 Mr. Stuart L. O'Byrne, Webster Groves, Missouri, observed the Light between 6:30 and 6:35 P.M. The apex was indistinct and lay near Beta in Pisces, about 5° north of the ecliptic. The whole body was north of the ecliptic, the ecliptic marking the south boundary through Aquarius. Towards the horizon in Capricornus a strong, bright inner cone was noticed, brighter than the galaxy in the central part of Cygnus. At 8:30 the Light was still visible but faint.

From Mr. J. Fraser Paterson, Broken Hill, N. S. W., Australia, a report has come of twelve observations during June, 1932. On June 4, 5, 6, 7, 8, 9, 10 he reports the Light as quite faint. On June 18 he found it bright and strong in Leo with an elongation from the horizon of 60°. (It is interesting to note that in our northern latitudes on account of the longer days of the summer season the Light was not visible in June in Leo.) On June 24 it was bright with a band about 8° wide to the Milky Way in Scorpio. In all instances the main body of the Light was south of the ecliptic.

From Mr. F. W. Smith, Glenolden, Pennsylvania, an interesting series of sketches of the Light observed on January 10, 21, February 4, March 13, 1931, has been received. On January 10 it was faint, the apex being indicated by Theta and Iota in Pisces. On January 21 it was fairly well defined with apex just south of Eta in Pisces. On February 4 it was quite conspicuous with apex slightly east of Alpha in Aries. On March 13 the apex was determined between the Pleiades and Hyades and Gamma in Aries was on the north boundary.

The writer observed the Light on December 20, 22, 29, January 15. With a remarkably clear sky on December 20 at 7:00 P.M., the Light was diffuse, the space between Delta in Capricornus and Beta in Aquarius being covered. The apex was ill-defined south of Alpha in Pegasus. On December 22 it could be traced to Gamma in Pisces. At 7:15 the whole body of the Light was dimmed; after a minute or two it brightened again, to be followed by another diminution. On January 15 after a week of continuous cloudy weather the sky was perfectly clear at 7:00 P.M. The Light was fairly strong especially near the horizon where it rivalled the galaxy in Cygnus. The apex was directly south of Gamma in Aries within two degrees of that star. At 8:00 P.M. the Light had shifted slightly southward so that Gamma in Pegasus which earlier was on the north boundary was then about 5° clear of it.

Morning Zodiacal Light. On November 14, 1931, Mr. F. W. Smith at 5:00 A.M., saw the Light in Virgo and Leo with apex about 8° east of Regulus. Beta in Virgo was on the central line of the luminosity. On December 8 Mr. Smith found the apex at Gamma in Virgo, Spica being on the south boundary and Alpha in Libra about central near the horizon.

On January 2 the writer observed the Light from 4:00 A.M. to 4:20. Gamma in Virgo marked the apex, Spica was just clear of the south boundary, about one-half of the space between Arcturus and Spica was covered and Alpha and Beta in Libra were both well within the body of the Light.

Gegenschein. On January 1 at 11:00 P.M., the writer observed the Gegenschein close to Epsilon in Gemini; shape was oval and elongated. On January 15 he found it at 10:00 P.M. directly south of Pollux, still oval and elongated; estimated diameters, E and W about 8°, N and S about 3°. Some observers have been of the opinion that the elongated shape of the Gegenschein is due to its projection on a Zodiacal band—but no band is noted in Gemini. During February the Gegenschein will be passing through Cancer towards the Leo Sickle and will become increasingly large and round as the vernal equinox approaches.

The Rectory, New Market, Maryland.

General Notes

Sir Frank Dyson, Astronomer Royal and director of the Greenwich Observatory since 1910, will terminate his connection with the Greenwich Observatory on February 28. He will be succeeded by Dr. Harold Spencer Jones, His Majesty's Astronomer at the Cape Observatory at the Cape of Good Hope. Dr. Jones, in turn, will be succeeded by Dr. J. Jackson, at present the chief assistant at the Greenwich Observatory.

The Gaertner Scientific Corporation has recently issued a new 32-page catalogue, a copy of which may be had upon request. This catalogue gives de-

tailed descriptions of the various optical instruments of precision which this well-known firm is equipped to furnish.

The Chicago Astronomical Society held its monthly meeting on January 5 at the Adler Planetarium. An illustrated address was given by Professor H. D. Curtis of the University of Michigan on his various eclipse expeditions, taking as a title "Around the World to Chase a Shadow." The McMath-Hulbert astronomical moving picture films were shown.

The Rittenhouse Astronomical Society held a meeting on January 10 at the Franklin Institute, Philadelphia, following a dinner at the Engineer's Club. Mr. O. H. Caldwell, editor of *Electronics*, was the speaker at the meeting, his subject being "Electrons and Stars."

Change in the Reduction of Occultations

Beginning with the first lunation of 1933 (New Moon, December 27, 1932) it is requested that 5″ be added to the moon's mean longitude instead of the 6″ used during the past four years. This is equivalent to the addition of $.152\,\Delta\alpha$, $.152\,\Delta\delta$ where $\Delta\alpha$, $\Delta\delta$ are the variations per minute, or to that of 0^h00253 to the time at which the moon's position is obtained from its ephemeris. In communicating results, the amount added should be stated.

1932 December 27. ERNEST W. BROWN AND DIRK BROUWER.

Book Reviews

A General Catalogue of the Radial Velocities of Stars, Nebulae, and Clusters, by Joseph Haines Moore. xvi + 220 pp. Publications of the Lick Observatory, Vol. XVIII, 1932. University of California Press, Berkeley, Calif.

This catalogue is much more than a mere compilation of radial velocities of stars, nebulae, and clusters. As in 1910 the publication of the Boss Preliminary General Catalogue marked an epoch in the determination of proper-motions by placing them upon a homogeneous system, so Moore's catalogue considerably enhances the value of the radial velocities thus far determined by establishing them upon a uniform system. The adjustment of observations taken in different localities with different instruments and the assignment of weights for their combination require a high degree of judgment and a considerable amount of basic material. In general one finds that the size of systematic differences between series of observations decreases with increase in the data. Dr. Moore is to be congratulated for his conservatism in adopting only such systematic corrections as seem to be definitely established.

The catalogue lists the radial velocities of over 6700 objects, about one-fifth of which have variable velocities, and contains all the data of this character published prior to January 1, 1932. For each star are given the Harvard Draper number, the star name or other designation, the 1900 position, Harvard magnitude, the Harvard and Revised spectral classification, the observing institution, the observed radial velocity with probable error, number of observations and instrumental dispersion, and finally the adopted weighted mean radial velocity with its probable error. These values are naturally not of equal weight and investigators should be cautioned against using them in statistical studies without consideration of the probable errors. Single plates, for instance, have been secured for many of

the fainter stars, notably 7.0 to 8.0 magnitude at Victoria and fainter than 9.0 at Lick. While these may give a fair representation in the mean of the radial velocities of these stars it must be recognized that individually they may be considerably in error and they should not be considered in a class with those velocities depending upon three or more plates.

The need of a comprehensive catalogue of radial velocities has been generally felt among astronomers for some time, and this authoritative work from the hands of one who has had a prominent part in securing the observations which go to make up the volume is a most welcome contribution to our fundamental astronomical data. R.E.W.

Astronomy for Young Folks, New Edition, by Isabel Lewis. (Duffield and Green, 200 Madison Avenue, New York City. Price $2.00.)

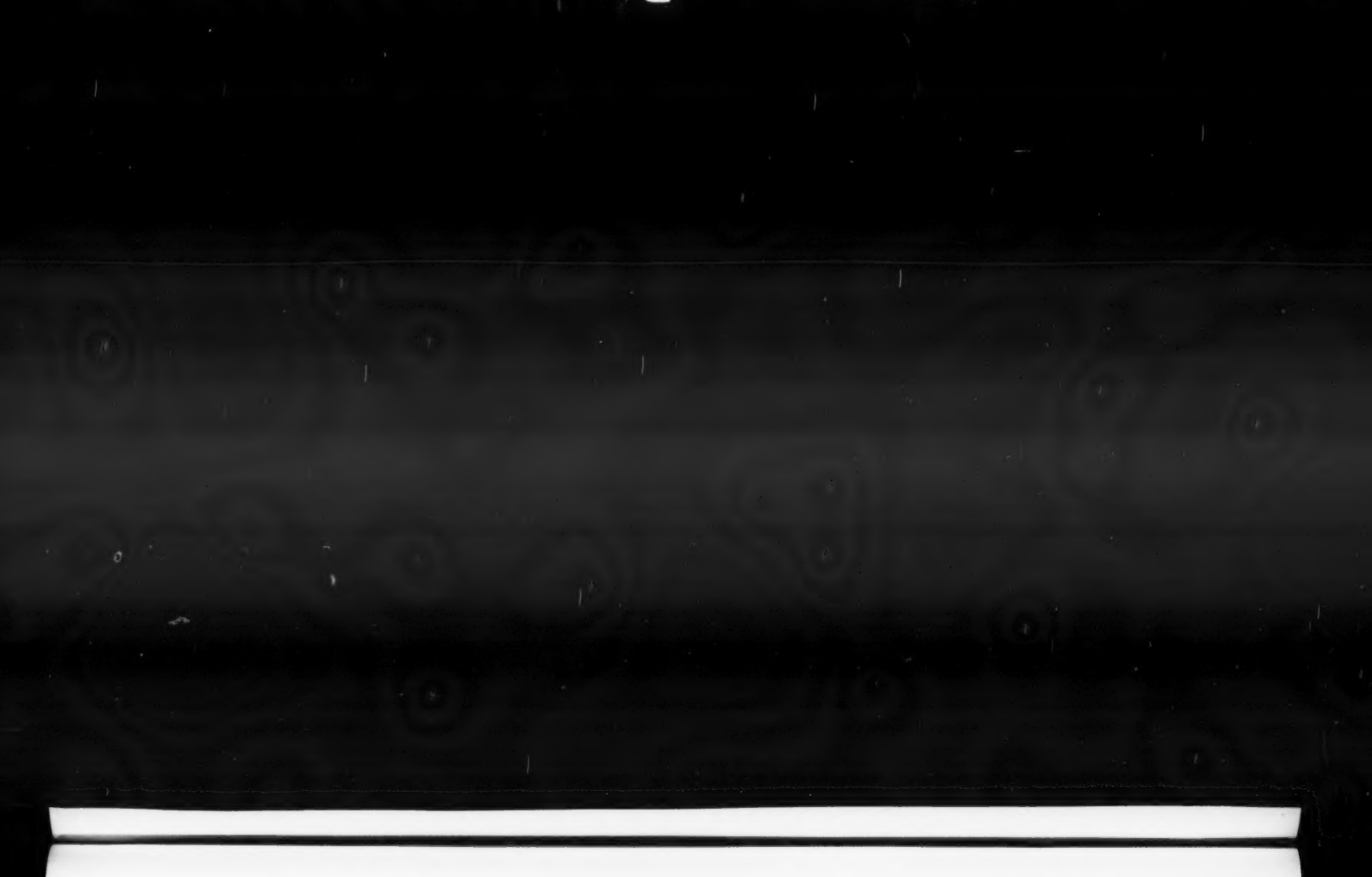
The publisher's page of this book shows it to have been copyrighted in the year 1921 and again in 1922. The present edition was issued in 1932. As is implied in the title the material is presented in a manner suitable to the ability of a beginner in the study of astronomy. It contains the fundamentals, a clear knowledge of which is essential to any work in this science. The writer begins with a discussion of the constellations, giving many diagrams and giving detailed description of the objects of special interest in the several constellations, and also stating clearly the time of year when they are visible. After the constellations, the usual features of the solar system, the Milky Way, meteorites, comets, and some of the simpler aspects of modern astronomical theory are presented.

An appendix consisting of fifty-five pages is devoted to eclipses. The book appeared at the time when the interest in the eclipse of August 31, 1932, was at its height, and doubtless was found helpful to many who had access to it before that date. However, inasmuch as all eclipses of the sun are alike in the principal features the suggestions given will be applicable to future eclipses as well. A list of useful tables is found in the closing pages.

The reviewer feels that the book is very well fitted to serve the purpose for which it is intended, and is pleased to recommend it to anyone who may wish to learn the elements of astronomy with a minimum of effort.

Philosophy and Modern Science, by Harold T. Davis. (The Principia Press, Bloomington, Indiana. Price $3.50.)

Anyone who has some grasp of the trend of modern science and a penchant for philosophy will, in the reviewer's judgment, find in this volume three hundred and twenty-four pages of stimulating and interesting reading. Historically there was a well-defined separation between the doctrines of science and philosophy. More than that there was a barrier between them which was impervious to both, so that neither could in any way influence the other. At present this barrier has been removed, science and philosophy have become so merged and intermingled that it is impossible to say where the realm of one ends and the realm of the other begins.

This is clearly indicated by the titles of the several sections in this book. For example: Science—The New Metaphysics, Immanuel Kant and the Subjective View, Ernest Mach—Relativity and Inertia, The Problem of Knowledge, What Keeps the Sun Hot?, and many others; in fact, almost any item taken at random from the contents.

Space here does not permit of detailed references. The book as a whole is to be recommended because of its clearness, its scope, its modernity, and its style.